FINAL

Level II Screening Ecological Risk Assessment
Portland Shipyard, Operable Unit 1
Swan Island Upland Facility

April 2011

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LIST OF ACRONYMS AND ABBREVIATIONS

5x-	Five times
%	Percent
90UCL	90th percentile Upper Confidence Limit
µg/kg	Micrograms per kilogram
ACA	Ash Creek Associates
bgs	Below Ground Surface
BTWP	Ballast Water Treatment Plant
COIs	Contaminants of Interest
CPECs	Contaminants of Potential Ecological Concern
CSM	Conceptual Site Model
DEQ	Department of Environmental Quality
EcoSSLs	Ecological Soil Screening Levels
ECSI	Environmental Cleanup Site Information
EPA	Environmental Protection Agency
EPCs	Exposure Point Concentrations
ERA	Ecological Risk Assessment
IG2	General Industrial 2
IH	Heavy Industrial
JSCS	Joint Source Control Strategy
LWG	Lower Willamette Group
MDCs	Maximum Detected Concentrations
mg/kg	Milligram per kilogram
NOAEL	No-observed-adverse-effects level
OAR	Oregon Administrative Rule
ODFW	Oregon Department of Fish and Wildlife
OHWL	Ordinary High Water Line
ONHP	Oregon Natural Heritage Program
ORNHIC	Oregon Natural Heritage Information Center
OU	Operable Unit
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PSY	Portland Shipyard
Q	Receptor Designator Value
RI/FS	Remedial Investigation/Feasibility Study
SCE	Source Control Evaluation
SIUF	Swan Island Upland Facility
SLVs	Screening Level Values
T	Toxicity Ratio
TBT	Tributyltin
T/E	Threatened and Endangered
TPH	Total Petroleum Hydrocarbons
TMDP	Technical-Management Decision Point
WAC	Washington Administrative Code
WDOE	Washington Department of Ecology
VCP	Voluntary Cleanup Program

1.0 INTRODUCTION

This document presents the final Level II Screening Ecological Risk Assessment (ERA) for the Swan Island Upland Facility (SIUF) Operable Unit 1 (OU1, or the Facility), Portland, Oregon. The Port of Portland (Port) has entered into a voluntary agreement for remedial investigation, source control measures, and feasibility study (Voluntary Agreement) with Oregon Department of Environmental Quality (DEQ) for the Facility, dated July 24, 2006. The SIUF was previously referred to by DEQ as the "Swan Island Portland Ship Yard" and identified by DEQ as Environmental Cleanup Site Information (ECSI) Site 271. OU1 consists of approximately 57 acres of upland property in the northwestern portion of the SIUF.

This final document incorporates DEQ comments received on March 30, 2011 on the draft Level II Screening ERA submitted to DEQ in March 2010 (Formation Environmental 2010). Responses to comments are presented in Appendix A.

1.1 Purpose and Scope

A Level I Scoping ERA was prepared and submitted in August 2008 (NewFields 2008) (Attachment A). Based on the results of the Level I Scoping ERA and DEQ site visit, DEQ requested a Level II Screening ERA for potential exposure of ecological receptors to surface soils in the vegetated area along the riverbank adjacent to the Ballast Water Treatment Plant (BWTP). This risk assessment report presents the scope of work, procedures used to complete, and results of a Level II Screening ERA for the Facility that meets the objectives of the Voluntary Agreement. This Level II ERA was based upon the process prescribed by the Oregon DEQ in the *Guidance for Ecological Risk Assessment: Levels I, II, III, IV* (DEQ 1998, with updates through 2001). The guidance describes a sequence for conducting ERAs, beginning with Level I Scoping. The purpose of the Level I ERA is to provide a conservative qualitative determination of whether there is reason to believe that ecological receptors and/or exposure pathways are present at OU1. If existing information indicates that site conditions will not result in exposure of ecological receptors, then no further risk analysis is necessary. If hazardous substances and exposure pathways are present, the process proceeds to a Level II Screening analysis to determine if hazardous substances are present at potentially ecotoxic concentrations and, if so, what additional risk analysis may be necessary to make risk management decisions for a facility. Based on the Level II Screening, recommendations for any further risk analysis are presented.

In accordance with the Voluntary Agreement, the scope of the Level II ERA at OU1 is limited to the upland areas above the ordinary high water line (OHWL) of the Willamette River. The scope of the ERA does not include adjacent sediments, submerged lands, and submersible lands of the river or the Swan Island Lagoon, certain facilities currently owned and operated by Cascade

General Ship Yard (e.g., dry docks, storm water conveyance systems), nor other adjacent upland sites. A Source Control Evaluation (SCE) to assess potential pathways, including transport of potentially erodable soils to the river will be developed and submitted under separate cover.

1.2 Facility Description

Figure 1-1 shows the location of the SIUF and the boundary of OU1.

1.3 Facility History

Swan Island was originally a periodically flooded sand bar and marsh with the main channel of the Willamette River located between the island and Mocks Bottom to the east. The Port developed Swan Island beginning in 1923, when the main navigation channel of the Willamette River was relocated to the western side of the island. River sediments dredged as part of the project were deposited on Swan Island to raise the surface elevation and construct a causeway connecting the island to the eastern shore of the river. This filling readied the island for development into the first Portland airport. Airport construction was completed and operations started in 1931. The airport operated until 1941, when it was relocated to northeast Portland.

Since the early 1940s, the area has been used for industrial purposes, principally ship construction and repair. Between 1942 and 1949, the US Maritime Commission and the War Assets Administration authorized Kaiser Shipbuilding and Consolidated Builders to perform ship-building, ship repair and ship-breaking on OU1. Between 1950 and 1995, the Port owned and managed the Portland Shipyard (PSY). Ship repair activities were conducted during this time period. The Port also leased certain buildings and facilities to various tenants. In 1995, Cascade General took over operation of the PSY and in 2000 purchased PSY, including OU1, from the Port. Additional site history is presented in the Draft Supplemental Preliminary Assessment, Swan Island Upland Facility, submitted to DEQ on December 18, 2006 (Ash Creek Associates/NewFields 2006).

1.4 Current and Future Facility Uses

OU1 is the upland property currently owned by Vigor Industrial, LLC (also known as Cascade General Ship Yard). Cascade General currently performs ship repair and maintenance, and constructs barges at OU1. Cascade General also leases space to tenants that perform metal fabrication and other industrial activities. According to City of Portland quarter-section zoning maps (Chapter 33.140 of Title 33, the Planning and Zoning Code), SIUF is designated for heavy industrial (IH) use. The zoning for OU1 includes a Greenway overlay zone of "i", which is the River Industrial Overlay Zone. The River Industrial Overlay Zone encourages and promotes the development of river-dependent and river-related industries which strengthen the economic

viability of Portland as a marine shipping and industrial harbor, while preserving and enhancing the riparian habitat and providing public access where practical. In addition, under Chapter 33.585 of Title 33, the Swan Island Plan District was established to foster the continuation and growth of the PSY (now the Cascade General Ship Yard), a unique waterfront basic industry. Other properties surrounding OU1 on Swan Island and across Swan Island Lagoon are zoned General Industrial 2 (IG2). No significant upland ecological resources are present within 1 mile of the OU1. No change in future land use is anticipated (Bridgewater Group 2007).

1.5 Summary of Level I Scoping ERA

A draft Level I Scoping ERA was prepared and submitted in May 2008 (NewFields 2008) with the overall conclusion of no unacceptable risks to upland receptors by contamination at the SIUF OU1. In a DEQ comment letter dated July 1, 2008, DEQ agreed with the overall conclusion of the Level I Scoping ERA. Based on other DEQ comments in the July 1, 2008 letter, a revised Level I Scoping ERA was submitted in August 2008 and is attached in Appendix B.

The overall Level I conclusion of no unacceptable risks to upland receptors by contamination at OU1 was based on limited or no ecological resource value; and therefore, highly unlikely to present significant risks to upland ecological receptors. Asphalt pavement, gravel, structures, fences, and riprap prevent extensive contact of plant and animal populations to onsite soils. As a result, there are incomplete or extremely limited exposure pathways for terrestrial plant and animal populations to soil or groundwater. The Level I evaluation recommended that further ecological evaluations of OU1 were unnecessary.

DEQ and the Port conducted a site visit in October 1, 2008 and DEQ indicated the following in a letter to the Port dated March 27, 2009:

- The vegetated area along the riverbank adjacent to the BWTP is sufficient and suitable ecological habitat;
- A review of the site file determined that the potential for contamination in this area exists (including the potential for aerial deposition from proximal/historical dry docks, based upon the historical ship repair and building activities in this area); and
- A Level II ERA should be conducted for this portion of the riverbank.

1.6 Document Organization

Section 2 includes the description of ecological site conditions. Section 3 presents the methodology and results of the Level II Screening analysis, including identification of contaminants of potential ecological concern (CPECs) and a preliminary conceptual site model (CSM). Technical-Management Decision Points (TMDPs) and overall conclusions are summarized in Section 4. References are provided in Section 5.

2.0 ECOLOGICAL SITE DESCRIPTION

A facility visit was conducted by the project lead ecological risk assessor in January 2008. The Level I Scoping ERA (NewFields 2008) presented an ecological site description based on the facility visit, aerial photographs, and general Facility knowledge. Site conditions have not changed appreciably since the site visit. Refer to the Level I Scoping ERA in Appendix B for photographs from the January 2008 site visit.

2.1 Site Description and Site-Specific Ecological Receptors

The Willamette River and Swan Island Lagoon surround SIUF on three sides. Over 97 percent of OU1 is comprised of developed areas including asphalt-covered parking lots, or gravel covered work areas, concrete slabs, or buildings (Figure 1-1). Existing vegetation on OU1 is ruderal, consisting of opportunistic or weedy annual species growing along the margins of roads or buildings, landscaped grass areas, or a few planted trees along roads and near buildings. The surface soil conditions and use of OU1 prevent the development of contiguous, extensive habitat. During the site visit, no receptors other than waterfowl and other birds associated with the river were observed at OU1. However, it is possible that songbirds may utilize the shrub areas during other parts of the year.

All of the riverbank area of SIUF has been modified by dredge/fill operations conducted to construct Swan Island and marine facilities. The riverbank at OU1 is mostly composed of piers, berths, bulkheads, and other structures or riprap. The only area of contiguous vegetation occur on the riverbank along the BWTP which includes a strip of shrubs (dominated by Himalayan blackberry and scotch broom) approximately 20 to 75 feet wide (Figure 2-1). This strip of shrubs is situated between a strip of riprap armoring that spans the water line at all but the highest river stages, and a landscaped grass area that extends up the slope to the working area of the OU1 surface (See photographs 9 through 13, Appendix B).

The depth to groundwater in OU1 ranges from 18 to 30 feet below ground surface (ft bgs), and there are no wetlands or permanent surface water bodies on OU1. OU1 is surrounded by industrial tracts and no significant upland ecological resources are present within 1 mile of OU1. The upland area will continue to be used for industrial purposes for the foreseeable future. The areas with small amounts of vegetation have limited habitat value because they are small, surrounded by paved areas or structures, distant from any other vegetated areas, and there are significant barriers and lack of any corridor to provide wildlife cover during travel. Therefore, use by wildlife is likely to be intermittent and transient. The Willamette River near the OU1 upland facility provides habitat for aquatic and semi-aquatic species. The river is identified as a sensitive environment in OAR 340-122-0115. The river adjacent to OU1 is being evaluated as

part of the Portland Harbor Superfund Site Remedial Investigation/Feasibility Study (RI/FS) ERA.

2.2 Threatened and Endangered Species

A listing of threatened and endangered (T/E) species potentially present within a two-mile radius of the project area was provided by the Oregon Natural Heritage Program (ONHP). The list includes historical presence of federal and state-listed T/E species. The Level I ERA in Appendix B summarizes the species listed by the ONHP. A copy of the letter from the ONHP identifying the species is also included in Appendix B.

Yellow-billed cuckoo is listed as a candidate T/E species in the vicinity. In the ONHP records, the last known observation of the yellow-billed cuckoo is along the Columbia River in 1985. According to the U.S. Fish and Wildlife Service species profile (USFWS 2008), Oregon counties in which the cuckoo is currently know to occur include: Harney, Deschutes, and Malheur. It is not listed as currently occurring in Multnomah County. Thus, no federally-listed T/E upland wildlife species are assumed to occur at the Facility.

2.3 Observed Impacts

Ecological resources (habitat or food sources) are extremely limited within OU1, restricted to the vegetated strip adjacent to the BWTP. No ecotoxicological impacts on ecological receptors were observed at OU1.

2.4 Other Ecologically Important Species/Habitats

Based on the Facility visit, historical information, Oregon Natural Heritage Information Center (ORNHIC) data, and general current Facility knowledge, there are no rare or ecologically unusual habitats or species at the Facility.

3.0 LEVEL II SCREENING ANALYSIS

3.1 Methods for Level II Screening

The ecotoxicological risk screen was conducted according to DEQ guidance for Level II Screening ERA (DEQ 2001). DEQ guidance specifies several tasks when the Level II analysis is conducted independently. However, many of the tasks and much of the background information cited in the Level II guidance were addressed in the Level I evaluation (i.e., conduct site survey, provide site description, identify ecological receptors, and identify complete exposure pathways) and summarized in Section 2. Therefore, the analysis presented below focuses on the tasks that relate directly to conducting the Level II screening, including:

- evaluate data sufficiency (Task 1 of the guidance);
- identify candidate assessment endpoints (Task 6);
- identify known ecological effects (Task 7);
- calculate COI concentrations (Task 8); and
- identify contaminants of potential ecological concern (CPECs) (Task 9).

3.1.1 *Data Available for Screening*

To support the data needs of a Level II ERA, twelve discrete surface soil samples (0 to 1 ft bgs) were collected along the BWTP in October 2009 (Figure 3-1). A data report memorandum describing the sampling and results is presented in Appendix C (Ash Creek Associates 2010). The samples were collected along the BWTP between the Ordinary Line of High Water (OLHW) on the river side and the asphalt/paved surface of the BTWP on the upland side. Samples were analyzed for a range of COIs including metals, total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and tributyltin (TBT). The data were approved by DEQ for use in the Level II ecotoxicity screen.

This Level II ERA focuses specifically on this soil data. Refer to Appendix D for a summary of soil sample results including detection frequency, minimum and maximum non-detected and detected concentrations.

3.1.2 Candidate Assessment Endpoints

According to DEQ guidance (2001), assessment endpoints are "...an explicit expression of a value deemed important to protect, operationally defined by an entity (hereafter, "endpoint receptor") and one or more of that entity's measurable attributes..." Assessment endpoints serve to focus the ERA on species and measures that are directly relevant to risk management

decisions for the site. The assessment endpoints generally represent species or functional groups that are important to ecological function at a site, or rare species that have great ecological, aesthetic, or cultural value.

Assessment endpoints for a screening level assessment (e.g., Level II screening) are typically not as specific as those identified for baseline risk assessments where specific measures or data analysis methods are needed to make decisions. For the DEQ Level II analysis, SLVs for soils have been identified for general groups of organisms including plants, invertebrates, birds, and mammals. No T/E or other rare species are known to use the Facility or expected to be present; and therefore, are not further considered for assessment endpoints. The following candidate assessment endpoints were identified:

- Survival, growth, and reproduction of terrestrial plants;
- Survival, growth, and reproduction of terrestrial invertebrates;
- Survival, growth, and reproduction of terrestrial-feeding birds; and
- Survival, growth, and reproduction of terrestrial-feeding mammals.

3.1.3 Calculating COI Concentrations

Because wildlife receptors do not experience their environment on a "point" basis, environmental data for each COI need to be converted to an estimate of concentration over a habitat exposure area (DEQ 2001). Exposure-point concentrations (EPCs) are concentrations of COIs that represent a reasonable maximum exposure based on the media characteristics and site-specific receptors. The Level II guidance specifies that screening level EPCs can be based on: (1) site maximum detected concentrations (MDCs) for immobile or nearly immobile receptors (i.e., plants and soil invertebrates), or (2) 90%-upper confidence limits (90UCL) of the mean concentrations for more mobile wildlife receptors (i.e., birds, mammals) (DEQ 2001).

EPCs of COIs for soil were calculated using data from riverbank locations to estimate reasonable maximum exposure for wildlife potentially visiting riverbank areas from adjacent locations. This approach assumes that wildlife receptors could utilize all areas of the riverbank; overall, riverbank habitat quality is considered low throughout.

Soil data used in the EPC calculations was from the 12, 0-1 ft surface soil samples collected specifically for this Level II ERA (Appendix C). For use in determining an EPC based on MDC and on 90UCL, all available sample results from the soil samples were included in the determination.

The EPA ProUCL computer program (EPA 2007, 2009) was used to obtain data distribution evaluations and to calculate the 90UCLs for COIs that exceeded Level II screening criteria based on MDC. In accordance with ProUCL guidance, each data set was first tested to

determine the data distribution and the appropriate 90UCL estimation method was chosen based on the best distribution fit and recommendations provided by ProUCL. DEQ guidance (DEQ 2001) suggests that non-detects should be included with values of one-half their detection limits. However, the latest ProUCL package includes computation methods (e.g., Kaplan-Meier) that can be used for datasests with non-detect values and so this methodology was used in 90UCL calculations.

3.1.4 Frequency of Detection and Background Analysis

COIs were screened on the basis of detection frequency and comparison to regional background levels before being compared to toxicity SLVs, as outlined in Task 9 of the Level II guidance (DEQ 2001). COIs detected in less than 5% of the samples were excluded as CPECs on the basis of infrequent detection (DEQ 2001). The MDCs for metals in soils were compared to regional background concentrations, as presented in the DEQ Toxicology Workgroup Memorandum (DEQ 2002). If the MDC for a COI was less than the background value, then the COI was excluded as a CPEC (DEQ 2001).

3.1.5 Screening Level Values (SLVs)

Screening values used in the Level II analyses were outlined by DEQ in a letter dated March 30, 2011 (Appendix A). For metals and PAHs, USEPA's Ecological Soil Screening Levels (EcoSSLs) were preferentially used where available (USEPA 2005 and updates). For diesel-range organics and PCBs, values used by the Washington Department of Ecology (WDOE) Toxics Cleanup Program ("Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals") were used for diesel-range organics and PCBs (Washington Administrative Code [WAC] 2011). For all other analytes, SLVs published by DEQ (2001) for use in Level II analyses were used in the screening level analysis. The screening values and sources are listed in Appendix D.

These screening values are based on no-observed-adverse-effects levels (NOAELs) for each of the COIs. Therefore, if site concentrations are less than the SLV, no adverse effects are expected and no further analysis is required because risk is assumed to be negligible. It should be noted that the SLVs are based on intensive use of a site by receptors. Because the Facility is industrialized, and will remain so, ecological receptors are unlikely to utilize the site at levels represented in the SLVs. Concentrations that exceed the SLV do not necessarily represent unacceptable risk, but indicate that additional evaluation of site conditions may be necessary to support risk management decisions.

3.2 Level II Screening Results and Identification of Contaminants of Potential Ecological Concern (CPECs)

CPEC identification followed Task 9 of the DEQ guidance (DEQ 2001), including consideration of detection frequency, background comparison, cumulative risk from multiple COIs, bioaccumulative toxins, and screening level availability. CPECs were identified by calculating the toxicity ratio (T) of the EPC (MDC or 90UCL) of each of the COIs to Level II SLVs (DEQ 2001). The guidance indicates two potential levels of analysis for soil COIs. For threatened or endangered species, the toxicity ratio is compared to the "receptor designator" (Q) value of 1 (i.e., if the riverbank soil concentration exceeds the SLV, the constituent is identified as a CPEC). For non-protected species, T is compared to a Q value of 5 (i.e., if the riverbank soil concentration exceeds five times [5x-] the SLV, the constituent is identified as a CPEC). For completeness, both levels of results are presented. However, CPECs are identified based on Q=5 because no T/E species are present at the site. In addition, potential risk to a receptor from multiple COIs simultaneously within a given medium was addressed by comparing T of an individual COI to the sum of T for all COIs.

Appendices D-1 through D-4 present results of soil screening based on MDCs for plant, invertebrate, bird, and mammal receptors. For each COI, the tables show a detailed data summary, the MDC, SLVs, and results of the data comparison. Appendix D-5 presents results of soil screening based on 90UCLs for all wildlife receptors and the output generated by ProUCL for calculation of 90UCL values is provided in Appendix D-6.

3.2.1 Frequency of Detection and Background Analysis

For riverbank soils at the Facility, MDCs of antimony and chromium were less than regional background concentrations and these analytes are excluded as CPECs (Appendix D), in accordance with Task 9 of DEQ guidance (DEQ 2001). MDCs of arsenic, copper, lead, mercury, nickel, and zinc exceeded regional background concentrations (Appendix D). Cadmium and silver were not detected in soil samples above 0.5 mg/kg detection limit.

Thirteen COIs were excluded as CPECs because there was less than 5% detection frequency for those analytes (DEQ 2001). None of those analytes was detected in riverbank soils. These analytes either: 1) don't have SLVs; or 2) have a maximum detection limit that doesn't exceed the SLV. No analytes for riverbank soils were excluded as CPECs based on frequency detection analysis where detects or detection levels exceeded SLVs.

3.2.1.1 Identification of Candidate CPECs

COIs for which the MDC exceeded at least one SLV with Q greater than 1 are considered "candidate CPECs" that are subject to further analysis, including calculation of 90UCLs, and comparison to appropriate risk ratios. In addition, candidate CPECs were also identified as a

result of potential risk to a receptor from multiple COIs simultaneously within a given medium (DEQ 2001).

Refer to Appendix D for results of the screen. For soils in OU1, seven candidate CPECs were identified: antimony, arsenic, copper, lead, mercury, nickel, and zinc. Although the chromium MDC exceeded the SLV; the Facility concentrations of chromium are below background level and therefore, this COI is not considered a CPEC.

3.2.1.2 Comparison of MDCs to SLVs for Non-Wildlife Receptors

Table 3-1 summarizes results of the soil toxicity screens based on comparison of MDCs to SLVs. The summary table indicates which MDCs exceeded SLVs with a risk ratio greater than 5 (i.e., the MDC was greater than 5x-SLV). As noted above, the Facility does not have suitable habitat for T/E species and so a risk ratio of 5 corresponding to non-T/E species is the applicable benchmark for identifying CPECs (DEQ 2001).

No CPECs were identified for plant or invertebrate receptors.

3.2.1.3 Comparison of 90UCLs to SLVs for Wildlife Receptors

For bird and mammal receptors (i.e., wildlife receptors), EPCs based on 90UCLs were calculated for all candidate CPECs (i.e., constituents with MDCs that exceeded an SLV). Refer to Appendix D-5 for the results of screens based on comparisons of the calculated 90UCLs to SLVs. Table 3-1 summarizes the results of the soil toxicity screens based on comparison of 90UCLs to SLVs. The summary table indicates which 90UCLs exceeded SLVs with a risk ratio greater than 5 (i.e., the 90UCL was greater than 5x-SLV). As noted above, the Facility does not have suitable habitat for T/E species and a risk ratio of 5 corresponding to non-T/E species is the applicable benchmark for identifying CPECs.

The risk ratio for copper was 5.1, which just marginally exceeds the Q=5 level identified by DEQ for non-T/E species. No other CPECs were identified for bird or mammal receptors.

It should be noted that the EcoSSL value for copper (26 mg/kg) is below the natural background level of copper in this area (36 mg/kg). For comparison purposes, the DEQ SLV value for birds exposed to copper in soil is 190 mg/kg and the WDOE value is 217 mg/kg. Of the 12 sampling locations, only one location had copper concentrations in soil that exceeded the level of 190 mg/kg. As noted above, SLVs are based on intensive use of a site by receptors. Because the Facility is industrialized, and will remain so, ecological receptors are unlikely to utilize the site at levels represented in the SLVs. For these reasons, it is not expected that levels of copper at the site are expected to cause significant adverse effects to bird populations.

3.3 Preliminary Site Conceptual Model

According to DEQ guidance, the last component of the ecotoxicity screening results section of the Level II ERA is development of a conceptual site model for the CPECs (Task 10, DEQ 2001). However, since no CPECs are recommended based on the SIUF OU1 data and screen, no CSM is needed to provide a basis for additional analysis.

4.0 ECOLOGICAL RISK ASSESSMENT CONCLUSIONS

According to DEQ guidance (2001), TMDPs are steps in the risk assessment process where one of three recommendations is determined: 1) no further ecological investigations at the site; 2) continuation of the risk assessment process to the next level; or 3) undertake a removal or remedial action. According to DEQ guidance, TMDP 3 is addressed at the end of the Level II screening process.

TMDP 3 is intended to help determine whether unacceptable ecological risk is probable. According to DEQ guidance (2001), the potential for risk exists when CPECs are present and there are complete exposure pathways between contaminated media and ecological receptors. The Level I scoping identified the presence of marginal quality habitat of limited size at the riverbank areas of the mostly industrial Facility. The Level I concluded that, because of the limited quality, small size and relatively isolation, the significant risk to local populations of non-T/E receptors was low. However, DEQ requested that a Level II ERA be conducted based on the potential for complete exposure pathways to contaminants that may have been transported to those areas.

The DEQ guidance indicates that unacceptable risk is probable only if the locality exhibits the following three criteria: 1) contains any individuals of a T/E species, critical habitat of a T/E species, or contains habitat of sufficient size and quality to support a local population of non-T/E species; 2) CPECs were selected on the basis of exceedance of SLVs or because they have a high potential to bioaccumulate; and 3) there appears to be plausible links between CPEC sources and endpoint receptors (DEQ 2001).

Based on the information presented in this document, the risk of unacceptable ecological impacts from chemicals at SIUF OU1 seems low, and no additional analysis to support risk management decisions is recommended. This recommendation is based primarily on the lack of significant exposures above DEQ threshold levels, and the relatively limited size and quality of habitat at the site. No further risk analysis, data collection, or remedial action is warranted for SIUF OU1 based on ecological risk.

5.0 REFERENCES

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TABLES

TABLE 3-1 Summary of CPECs - Riverbank Area Soils

Swan Island OU1 Upland Facility

Analyte (COIs)	Plants[1]	Invertebrates[1]	Birds[2]	Mammals[2]
	Non-T/E Species (HQ>5)	*Non-T/E Species (HQ>5)*	*Non-T/E Species (HQ>5)*	*Non-T/E Species (HQ>5)*
	MDC	MDC	90UCL	90UCL
Antimony	NO	NO	--	NO
Arsenic	NO	NO	--	NO
Copper	NO	NO	YES	NO
Lead	NO	NO	NO	--
Mercury	NO	NO	--	--
Nickel	NO	NO	--	--
Zinc	NO	NO	NO	NO

Notes:
CPECs - contaminants of potential ecological concern
COIs - constituents of interest
MDC - maximum detected concentration
90UCL - 90% upper confidence limit
HQ - hazard quotient
-- = indicates that there is no screening level for the receptor

1 - For plants and invertebrates, CPECs are COIs whose MDCs exceed screening levels at the Q=5 level for non-T/E species and background.

2 - For birds and mammals, CPECs are COIs whose 90UCLs exceed screening levels at the Q=5 level for non-T/E species and background.

FIGURES

S:\GIS\ARCPRJ2\010116\PLT\SIUF_OU1_ERA\FIG1-1_SIUF_OU1_ERA.MXD

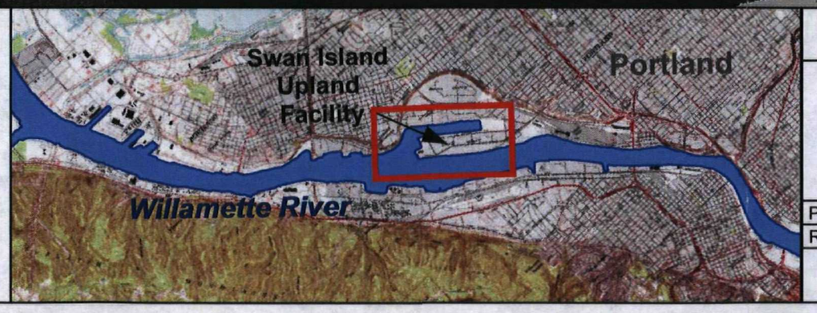
Legend

Approximate OU1 Boundary

Notes:
- Approximate OU1 Boundary based on boundary as defined by VCP Agreement (2006) and Ordinary High Water Line (OHWL) - at 16.6 feet above mean sea level, National Geodetic Vertical Datum of 1929
- Aerial Photography - July 2007

N

0 245 490 980 Feet



SWAN ISLAND UPLAND FACILITY
PORT OF PORTLAND, OREGON

FIGURE 1-1

SWAN ISLAND UPLAND FACILITY OPERABLE UNIT 1 (OU1)

PRJ: 0219-018-900	DATE: MAR 01, 2010	
REV: 0	BY: RLW	CHK: MCL

FORMATION ENVIRONMENTAL

S:\GIS\ARCPRJ2\010116\PLT\SIUF_OU1_ERA\FIG2-1_SIUF_OU1_ERA.MXD

Legend

Approximate OU1 Boundary

Notes:
- Approximate OU1 Boundary based on boundary as defined by VCP Agreement (2006) and Ordinary High Water Line (OHWL) - at 16.6 feet above mean sea level, National Geodetic Vertical Datum of 1929
- Aerial Photography - July 2007

N

0 45 90 180 Feet

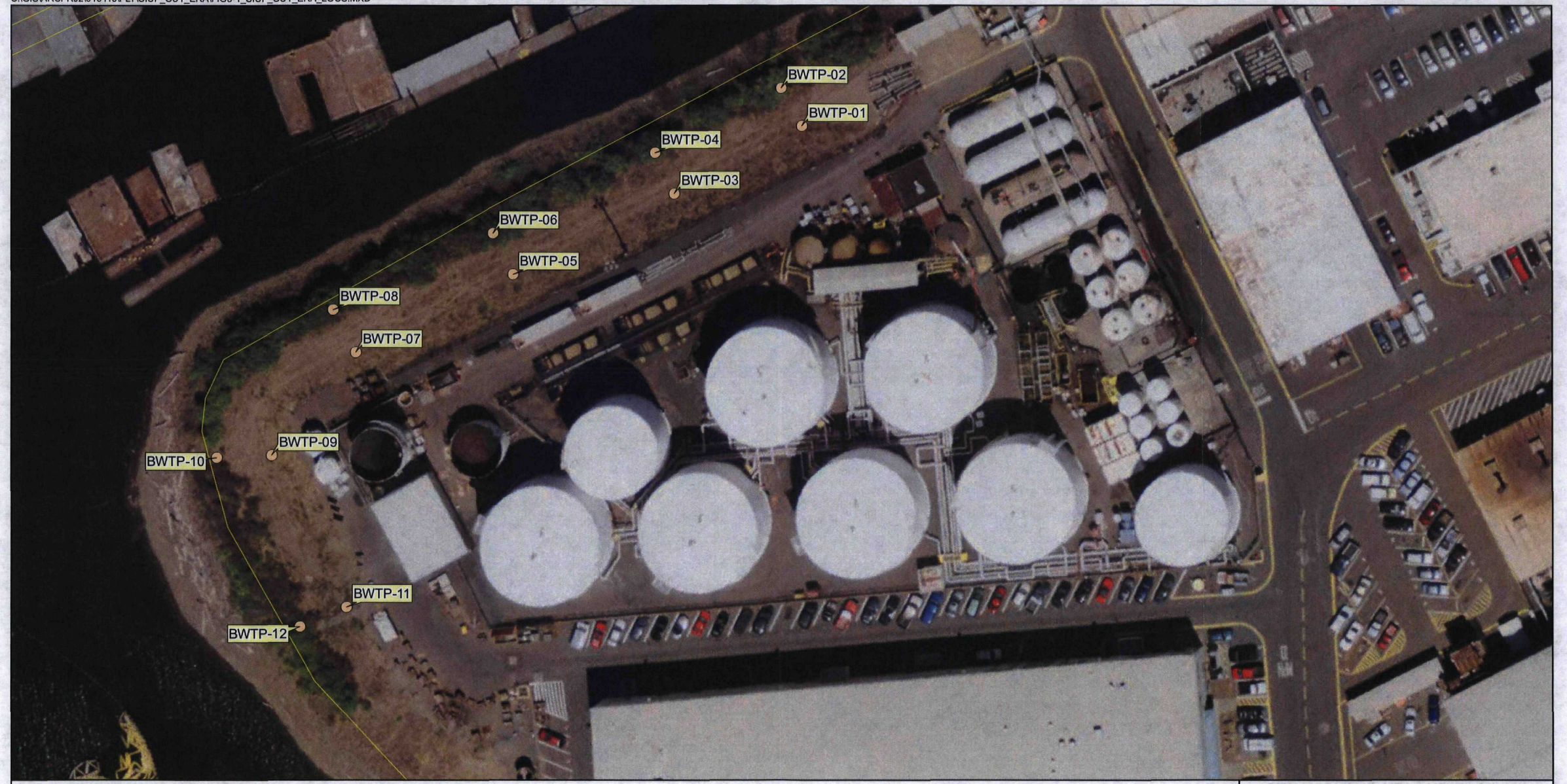
SWAN ISLAND UPLAND FACILITY
PORT OF PORTLAND, OREGON

FIGURE 2-1
RIVERBANK NEAR BALLAST WATER TREATMENT PLANT
SWAN ISLAND UPLAND FACILITY
OPERABLE UNIT 1 (OU1)

PRJ: 0219-018-900	DATE: MAR 04, 2010	
REV: 0	BY: RLW	CHK: MCL

FORMATION ENVIRONMENTAL

S:\GIS\ARCPRJ2\010116\PLT\SIUF_OU1_ERA\FIG3-1_SIUF_OU1_ERA_LOCS.MXD



Legend

- Approximate OU1 Boundary
- Sample Location

Notes:
- Approximate OU1 Boundary based on boundary as defined by VCP Agreement (2006) and Ordinary High Water Line (OHWL) - at 16.6 feet above mean sea level, National Geodetic Vertical Datum of 1929
- Aerial Photography - July 2007

N

0 40 80 160 Feet

SWAN ISLAND UPLAND FACILITY
PORT OF PORTLAND, OREGON

FIGURE 3-1

SOIL SAMPLE LOCATIONS
SWAN ISLAND UPLAND FACILITY
OU1

PRJ: 007-018	DATE: MAR 03, 2010	
REV: 0	BY: RLW	CHK: MCL

FORMATION ENVIRONMENTAL

APPENDIX A
Responses to Oregon Department of Environmental Quality Comments

Responses to Oregon Department of Environmental Quality Comments Received in a Letter to Port of Portland on March 30, 2011 on the Draft Level II Screening Ecological Risk Assessment, Swan Island Upland Facility, Operable Unit 1 (March 2010)

The Department of Environmental Quality (DEQ) reviewed the March 2010, Level II Screening Ecological Risk Assessment Portland Shipyard, Operable Unit 1, prepared for the Port of Portland by Ash Creek Associates.

DEQ agrees with the report's conclusions. For the upland portion of Operable Unit 1 (OU1) there are no unacceptable risks to ecological receptors.

DEQ request that the Final Level II Screening ERA Operable Unit 1 Swan Island Facility address the following comments:

Specific Comments

1. Page 8. The EPA ProUCL computer program was used to obtain data distribution evaluations and to calculate the 90%UCLs for COIs that exceed Level II screening criteria. DEQ request that the 90% UCL calculation output from Pro UCL software be submitted as an appendix.

Response: The 90% UCL calculation output from ProUCL is submitted as Appendix D-6 in the final report. (Note that 95% UCL calculation output is also included in Appendix D-6 for reasons that are articulated in the Appendix. Only the 90% UCLs were used in the Level II analysis.)

2. Appendix C-1, Riverbank Risk Screening: DEQ soil values are currently outdated for several SLVs. The following should be used in the risk screening for the final report:

Metals: Where available, EPA Eco SSLs should be used instead of DEQ SLVs. This will change the values for some metals, but does not change the conclusions of the risk assessment.

Response: EPA's Ecological Soil Screening Levels (EcoSSLs) were used preferentially in the risk screening, as available for analytes and receptor groups. As indicated in the comment, this does change the screening values (e.g., copper EcoSSL is 28 mg/kg, below the regional background value of 36 mg/kg and also below the DEQ screening level value [SLV] of 190 mg/kg), but does not change the overall conclusions of the risk assessment. Refer to Section 3.2.1.3 of the final report for further discussion.

PAHs: EPA national ecological soil screening levels should be used in the screening. This change results in total HPAHs screening in for the risk assessment based on a NOAEL. However, these values do not exceed population level benchmarks (LOAEL approximated as 5x the values below).

- Low Molecular Weight PAHs (2-3 rings): 29 mg/kg soil invertebrates; 100 mg/kg mammalian
- High Molecular Weight PAHs (>4 rings): 18 mg/kg soil invertebrates; 1.1 mg/kg mammalian

Response: EPA's EcoSSLs were used preferentially in the risk screening, as available for analyte groups and receptor groups. As implied in the comment, this change does not appear to affect the screening. The maximum result of any PAH is 0.409 mg/kg, which is well below the lowest available EcoSSL of 1.1 mg/kg. Using these values did not change the conclusions of the risk assessment.

3. TPH: TPH values for evaluation of terrestrial risk are available from Washington Department of Ecology MTCA. The values for gasoline range organics are 100 mg/kg for protection of soil invertebrates and 5,000 mg/kg for wildlife; for diesel range organics 200 mg/kg for invertebrates and 6,000 mg/kg for wildlife. These values do not change the conclusions of the risk assessment.

Response: Values used by the Washington Department of Ecology (WDOE) Toxics Cleanup Program ("Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals"; Washington Administrative Code [WAC] 2011) were used for diesel-range organics, as available for receptor groups. Using these values did not change the conclusions of the risk assessment.

4. Appendix C-3 and C-4, Risk Summary for Birds and Mammals: DEQ's terrestrial soil screening values do not include the bioaccumulation pathway. For PCBs, the ERA should evaluate a bioaccumulation screening level value, which are available from several sources and range from 0.371 mg/kg (Oak Ridge National Laboratory) to 0.65 mg/kg (Washington Department of Ecology). Two samples had concentrations above 0.371 mg/kg with a maximum detected concentration of total PCBs of 0.424 mg/kg. However, these values do not exceed population level benchmarks (LOAEL approximated as 5x the values below).

Response: Values used by the WDOE Toxics Cleanup Program ("Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals"; WAC 2011) were used for PCBs, as available for receptor groups. Using these values did not change the conclusions of the risk assessment.

References:

U.S. Environmental Protection Agency (EPA). 2005. Guidance for Developing Ecological Soil Screening Levels (EcoSSLs). EPA Office of Solid Waste and Emergency Response (OSWER), OSWER Directive 9285.7-55. Published November 2003, Revised November 2005 and subsequent contaminant-specific EcoSSL documents.

Washington Administrative Code (WAC). 2011. Table 792-3 (Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals), Chapter 173-340. Implementing regulations of the Toxics Control Act (MTCA); used by Washington Department of Ecology (WDOE), Toxics Cleanup Program, Terrestrial Ecological Evaluation Process. Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/table_749-3.htm. Accessed 4/12/2011.

APPENDIX B
Level I Scoping Ecological Risk Assessment, Swan Island Upland Facility Operable Unit 1

Level I Scoping Ecological Risk Assessment
Swan Island Upland Facility
Operable Unit 1
Portland, Oregon

August 2008

Prepared for:

Ash Creek Associates, Inc.
9615 SW Allen Boulevard
Suite 106
Portland, OR 97005

On Behalf of:

Port of Portland
121 NW Everett
Portland, OR 97209

Prepared by:

NEWFIELDS
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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Description
ACA	Ash Creek Associates
BWTP	Ballast Water Treatment Plant
CGSRY	Cascade General Ship Repair Yard
COIs	Contaminants of Interest
ECSI	Environmental Cleanup Site Information
ERA	Ecological Risk Assessment
ft bgs	Feet Below Ground Surface
FS	Feasibility Study
GIS	Geographic Information System
IH	Heavy Industrial
JSCS	Joint Source Control Strategy
LWG	Lower Willamette Group
NF	NewFields
NRI	Natural Resource Inventory
OAR	Oregon Administrative Rule
DEQ	Oregon Department of Environmental Quality
OHWL	Ordinary High Water Line
ONHIC	Oregon Natural Heritage Information Center
OU	Operable Unit
PAHs	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
Port	Port of Portland
PSY	Portland Shipyard
RI	Remedial Investigation
SIUF	Swan Island Upland Facility
T/E	Threatened and Endangered
TMDP	Technical-Management Decision Point
TPHs	Total Petroleum Hydrocarbons
USEPA	U.S. Environmental Protection Agency
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

Investigation activities are being conducted at the Swan Island Upland Facility (SIUF) under a *Voluntary Agreement for Remedial Investigation, Source Control Measures, and Feasibility Study (DEQ No. WPMVC-LQVC-NWR-06-07),* effective July 24, 2006 (hereafter referred to as Voluntary Agreement). This agreement is between the Port of Portland (Port) and the Oregon Department of Environmental Quality (DEQ). The SIUF was previously identified by the DEQ as Environmental Cleanup Site Information (ECSI) site 271, Portland Shipyard (PSY). For purposes of investigations, the SIUF has been divided into three operable units (OUs), and OU1 is the upland property owned by Cascade General, referred to as the Cascade General Ship Repair Yard (CGSRY).

The Level I Scoping Ecological Risk Assessment (ERA) for OU1 of the SIUF presented in this document was based upon the process prescribed by the DEQ in the *Guidance for Ecological Risk Assessment: Levels I, II, III, IV* (DEQ, 1998 with updates through 2001). The guidance describes a sequence for conducting ERAs, beginning with Level I Scoping. The purpose of the Level I Scoping ERA is to provide a conservative qualitative determination of whether there is reason to believe that ecological receptors and/or exposure pathways are present at OU1. If existing information indicates that site conditions will not result in exposure to ecological receptors, then no further risk analysis is necessary. If hazardous substances and exposure pathways are present, the process proceeds to a Level II screening analysis to determine if hazardous substances are present at potentially ecotoxic concentrations and, if so, what additional risk analysis may be necessary to make risk management decisions for a facility.

DEQ guidance for the Level I ERA deliverable was used as the basis for organizing this ERA. Section 1 presents the location, history, current uses, and ecological features of OU1 relevant to the Scoping ERA. Additional detailed information is presented in the *Phase II Remedial Investigation Work Plan Addendum for Operable Unit 1* (Bridgewater Group 2007a). Section 2 summarizes the constituents of interest (COIs) and Section 3 details the relevant exposure pathways for OU1. Section 4 provides the recommendations of the Level I scoping process. The Level I deliverable also includes a checklist for summarizing OU1 features based on a site visit, and a form for evaluating potential receptor-pathway interactions. These forms are included as Attachments 2 and 3 to this ERA.

1.1 Site Location

OU1 is an upland facility located on Swan Island off the east bank of the Willamette River between River Miles 8 and 9.2, Portland, Oregon (Figure 1). Figure 1 shows the location of the SIUF, the boundary of OU1, and aerial photography of the area. According to the Voluntary

Agreement, SIUF is comprised of 94 acres, and OU1 includes the approximately 57 acres of uplands in the northwestern portion of Swan Island.

In accordance with the Voluntary Agreement, the scope of the Level I ERA at OU1 is limited to the upland areas above the ordinary high water line (OHWL) of the Willamette River. The scope of the ERA does not include adjacent sediments, submerged lands, and submersible lands of the river or the Swan Island Lagoon, certain facilities currently owned and operated by Cascade General (e.g., dry docks, storm water conveyance systems), nor other adjacent upland sites. For details about the scope of the investigations, refer to the Voluntary Agreement.

1.2 Site History

Swan Island was originally a periodically flooded sand bar and marsh with the main channel of the Willamette River located between the island and Mocks Bottom to the east. The Willamette River on the west side of the island was too shallow for ship navigation. In 1923, the main channel of the Willamette River was relocated from the east to the west side of the island. A causeway was built in the east channel from the mainland to the island, and the south end of Mocks Bottom was raised, making a peninsula of the island and creating a still-water lagoon of the east channel. Additional geological and hydrogeological information is provided in Bridgewater Group (2007a).

Prior to the early 1940s, OU1 was part of the Portland Municipal Airport. Since then, the area has been used for industrial purposes, principally ship construction and repair. Between 1942 and 1949, the US Maritime Commission and the War Assets Administration authorized Kaiser Shipbuilding and Consolidated Builders to perform ship-building, ship repair and ship-breaking on OU1. Between 1950 and 1995, the Port owned and managed the PSY. Ship repair activities were conducted during this time period. The Port also leased certain buildings and facilities to various tenants. In 1995, Cascade General took over the PSY and in 2000 purchased PSY, including OU1, from the Port. Additional site history is presented in the *Draft Supplemental Preliminary Assessment, Swan Island Upland Facility*, submitted to DEQ on December 18, 2006 (Ash Creek Associates/NewFields [ACA/NF] 2006).

1.3 Current Site Use

OU1 is the upland property owned by Cascade General. Cascade General currently performs ship repair and maintenance, and constructs barges at OU1. Cascade General also leases space to tenants that perform metal fabrication and other industrial activities. According to City of Portland quarter-section zoning maps (Chapter 33.140 of Title 33, the Planning and Zoning Code), SIUF is designated for heavy industrial (IH) use. The zoning for OU1 includes a Greenway overlay zone of "i", which is the River Industrial Overlay Zone. The River Industrial Overlay Zone encourages and promotes the development of river-dependent and river-related

industries which strengthen the economic viability of Portland as a marine shipping and industrial harbor, while preserving and enhancing the riparian habitat and providing public access where practical. In addition, under Chapter 33.585 of Title 33, the Swan Island Plan District was established to foster the continuation and growth of the PSY (now referred to as the CGSRY), a unique waterfront basic industry. No change in future land use is anticipated (Bridgewater Group 2007a).

OU1 is surrounded by similarly developed, industrial tracts. Other properties on Swan Island and across Swan Island Lagoon are zoned General Industrial 2 (IG2). The SIUF is bounded to the southwest and northwest by the Willamette River and Swan Island Lagoon.

1.4 Ecological Features and Sensitive Environments

An overall description of the location, physical features, current uses, and history of SIUF is presented in the *Phase II RI Addendum* for OU1 (Bridgewater Group 2007a). The following sections are intended to supplement that information for elements relevant to the Level I Scoping. The ecological features are described based on facility visits, aerial photographs, and general Facility knowledge. Attachment 1 contains photos of the facility taken during a site visit in January 2008. Refer to Attachment 2 (Level I Ecological Scoping Checklist) and Attachment 3 (Level I Evaluation of Receptor-Pathway Evaluations), as required by DEQ (2001).

The Willamette River and Swan Island Lagoon surround SIUF on three sides. Over 97 percent of OU1 is comprised of developed areas including asphalt-covered parking lots, or gravel-covered work areas, concrete slabs, or buildings (Figure 1). Any existing vegetation on this part of the disturbed upland area is ruderal, consisting of opportunistic or weedy annual species growing along the margins of roads or buildings, landscaped grass areas, or a few planted trees along roads and near buildings. The surface soil conditions and use of OU1 prevent the development of contiguous, extensive habitat.

All of the riverbank area of SIUF has been modified by dredge/fill operations conducted to construct Swan Island and the construction of marine facilities. The riverbank at OU1 is mostly composed of piers, berths, bulkheads, and other structures or riprap (Figure 1). The only areas of contiguous vegetation occur on the riverbank along the Ballast Water Treatment Plant (BWTP), and include a narrow (3-5 m) strip of shrubs (dominated by Himalayan blackberry and scotch broom). This strip of shrubs is situated between a strip of riprap armoring that spans the water line at all but the highest river stages, and a landscaped grass area that extends up the slope to the working area of the OU1 surface (See photographs 9, 10, 11, Attachment 1).

The depth to groundwater in OU1 ranges from 18 to 30 feet below ground surface (ft bgs), and there are no wetlands or permanent surface water bodies on OU1.

Industrial development in the vicinity significantly limits the habitat potential of this facility. OU1 is surrounded by industrial tracts and no significant upland ecological resources are present within 1 mile of OU1. The upland area will continue to be used for industrial purposes. The areas with small amounts of vegetation have limited habitat value because they are small, surrounded by paved areas or structures, distant from any other vegetated areas, and there are significant barriers and lack of any corridor to provide wildlife cover during travel. Any wildlife use would be intermittent. OU1 does not currently and will not provide suitable habitat for ecological receptors because of former, current, and reasonably likely future uses of the property.

The Willamette River near the OU1 upland facility provides habitat for aquatic and semi-aquatic species. The river is identified as a sensitive environment in OAR 340-122-0115. As discussed in detail in Section 4.0, the beach area and river adjacent to OU1 are being evaluated as part of the Portland Harbor Superfund Site Remedial Investigation/Feasibility Study (RI/FS) ERA and a separate Joint Source Control Strategy (JSCS) evaluation.

1.5 Threatened and Endangered Species

A listing of threatened and endangered (T/E) species potentially present in the area was provided by the Oregon Natural Heritage Information Center (ONHIC). The list includes historical presence of federal and state-listed species. Attachment 4 to this ERA summarizes the species listed by the ONHIC.

According to ONHIC information, areas within 2 miles of SIUF potentially contain habitat for several terrestrial or semi-terrestrial species of interest, including one plant species, several bird species, one bat species, and one turtle species. Peregrine falcons are federally listed T/E species that are known to nest in other areas along the Willamette River, but SIUF does not contain habitat suitable for this species. Thus, no T/E species are known to inhabit the SIUF.

Areas within 2 miles of SIUF potentially contain habitat for several fish species of interest, however, OU1 does not provide aquatic habitat in which these fish species would be found. As discussed in detail in Section 4.0, the beach area and river adjacent to OU1 are being evaluated as part of the Portland Harbor Superfund Site RI/FS ERA and a separate Joint Source Control Strategy (JSCS) evaluation.

2.0 CONSTITUENTS OF INTEREST (COIs)

In accordance with the Voluntary Agreement, the potential hazardous substances (i.e., COIs) in soil and groundwater at OU1 are metals, volatile organic compounds (VOCs), total petroleum hydrocarbons (TPHs), polynuclear aromatic hydrocarbons (PAHs), butyltins, and

polychlorinated biphenyls (PCBs). Sampling of surface and subsurface soils and groundwater was conducted at OU1 prior to the sale of the Portland Shipyard to Cascade General, and during the Phase IA, IB, and II Portland Shipyard Remedial Investigations. For purposes of the investigation, OU1 was divided into two areas: 1). BWTP and Building 72 Area and 2). Main Shipyard Area. A summary of the sampling events and the analytical results are presented in Bridgewater Group (2007a).

2.1 COIs in Soil

Metals, PCBs, TPHs, and PAHs were detected in surface and subsurface soils within the BWTP and Building 72 area (Bridgewater Group 2007a). Elsewhere on OU1, metals, PCBs, TPHs, PAHs, and VOCs were detected in surface and subsurface soils (Bridgewater Group 2007a).

2.2 COIs in Groundwater

Metals, VOCs, and PAHs were detected in groundwater samples within the BWTP and Building 72 area. Elsewhere on OU1, metals, VOCs, and PAHs were detected in groundwater samples.

Based on groundwater samples collected in December 2006, metals, VOCs and PAHs were not detected in OU1 groundwater at concentrations exceeding ecological screening levels (i.e., USEPA ambient water quality criteria or DEQ freshwater Level II ecological screening levels) (Bridgewater Group 2007b).

2.3 Observed Impacts

No ecotoxicological impacts on ecological receptors have been observed at OU1. As indicated above, there are no ecological resources (habitat or food sources) located within the working area of OU1. No receptors other than waterfowl and other birds associated with the river have been observed at OU1.

3.0 EXPOSURE PATHWAYS

A general evaluation of potential exposure pathways is provided in the Level I Scoping checklists in Attachments 2 and 3.

Most of OU1 is covered by buildings, asphalt, pavement, or gravel and does not represent an ecological resource. Onsite soils are paved, covered by structures, fenced, or otherwise inaccessible to contact by ecological receptors. Vegetation is very limited, and where it exists, it consists mostly of introduced or planted species and is surrounded by paved areas and

structures. The riverbank areas are mostly occupied by structures or riprap and also do not provide extensive habitat for ecological receptors. Site topography prevents overland soil transport to the riverbanks. As a result, wildlife are unlikely to visit or feed at OU1 and would not be significantly exposed to surface soil contaminants.

As noted above, there are no surface water bodies on OU1. Groundwater is at least 18 feet below ground surface and contaminants have not been detected at concentrations exceeding ecological screening levels. Therefore, exposure of terrestrial receptors to site-specific contaminants on the upland or riverbank areas is unlikely.

In accordance with DEQ policy for the Portland Harbor, risk assessments for upland facilities will not include receptors or pathways in the Willamette River. Potential indirect contact of river-related receptors to groundwater or erodable soils from OU1 is addressed in a separate Joint Source Control Evaluation (JSCS) evaluation, in accordance with DEQ/USEPA (2005), in Bridgewater Group (2007a).

4.0 RECOMMENDATIONS

The goal of the Level I scoping evaluation is to determine whether there is any reason to believe that ecological receptors and/or exposure pathways are present or potentially present at the Facility. Scoping is intended to identify sites that are obviously devoid of ecological important species or habitats and/or where exposure pathways are obviously incomplete (DEQ 2001). The Level I scoping evaluation presented in this document yields the following conclusions: 1) there are no significant ecological resources at OU1; and 2) asphalt, paving, gravel, structures, fences, and riprap prevent extensive contact of plant and animal populations to onsite soils. As a result, there are incomplete or extremely limited exposure pathways for terrestrial plant and animal populations to soil or groundwater at OU1.

According to DEQ guidance (2001), technical management decision points (TMDPs) are steps in the risk assessment process where one of the following three recommendations is determined: 1) no further ecological investigations at the site; 2) continuation of the risk assessment process to the next level; or 3) undertake a removal or remedial action. DEQ guidance identifies a TMDP at the end of the Level I scoping process to determine if ecological risk is suspected. This Level I scoping evaluation concludes that OU1 has limited or no ecological resource value and is highly unlikely to present significant risks to upland ecological receptors, and further ecological evaluations of OU1 are deemed unnecessary.

There are no known pathways for the transport of hazardous substances in groundwater or erosional movement of soils impacted by hazardous substances in OU1 to the river. However, in accordance with DEQ policy, this evaluation excludes explicit evaluation of pathways or exposure to aquatic receptors in the Willamette River. The beach area and river adjacent to

OU1 are being evaluated as part of the Portland Harbor RI/FS ERA. In addition, potential exposure to river-related receptors from indirect exposure to soil and groundwater is evaluated as part of a separate JSCS evaluation presented in Bridgewater Group (2007a).

5.0 REFERENCES

Ash Creek Associates/NewFields (ACA/NF). 2006. Draft Supplemental Preliminary Assessment, Swan Island Upland Facility, Portland, Oregon. Prepared for the Port of Portland.

Bridgewater Group, Inc. 2007a. Phase II Remedial Investigation Work Plan Addendum for Operable Unit 1, Swan Island Upland Facility, Portland, Oregon. Prepared for the Port of Portland.

Bridgewater Group, Inc. 2007b. 2006 Annual Groundwater Monitoring Results, Swan Island Upland Facility, Portland, Oregon. Prepared for the Port of Portland.

Oregon Department of Environmental Quality (DEQ). 2001. *Guidance for Ecological Risk Assessment: Levels I, II, III, IV.* Waste Management & Cleanup Division, Final April 1998, updated May 2001.

Oregon Department of Environmental Quality (DEQ) and U.S. Environmental Protection Agency (USEPA). 2005. Portland Harbor Joint Source Control Strategy, Final, December 21, 2005. Updates at http://www.deq.state.or.us/nwr/Portland Harbor/jscs.

FIGURES

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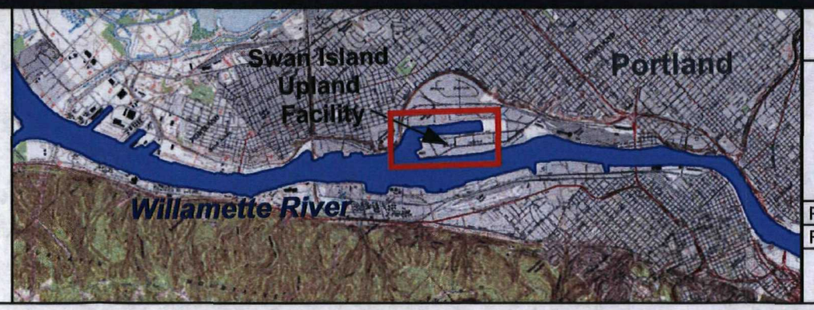
Legend

OU1 Boundary

Boundary partially based on Ordinary High Water Line (OHWL)- at 16.6 feet above mean sea level, National Geodetic Vertical Datum of 1929

N

0 312.5 625 1,250 Feet



SWAN ISLAND UPLAND FACILITY
PORT OF PORTLAND, OREGON

FIGURE 1

LOCATION OF OPERABLE UNIT 1

PRJ: 0219-018-900	DATE: DEC 28, 2007	
REV: 0	BY: RCR	CHK: MCL

NEWFIELDS

ATTACHMENT 1

Site Photos (January 2008)
For Operable Unit 1, Swan Island Upland Facility

Photo 1. Center of SIUF near Paint Sheds and Bays 6, 7, 8, and 9.

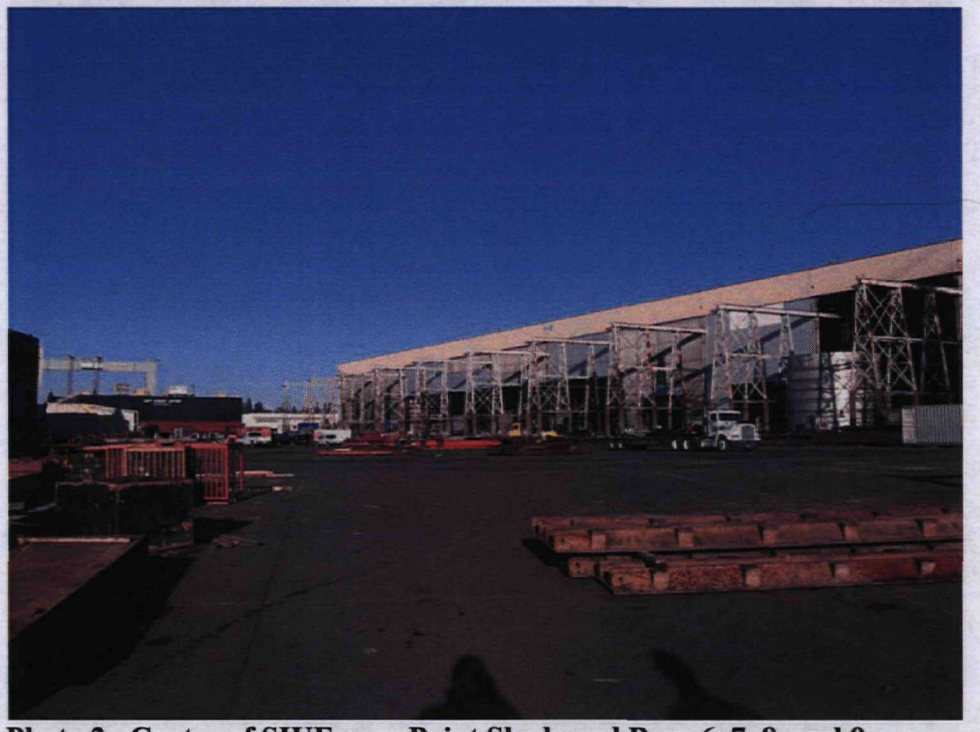


Photo 2. Center of SIUF near Paint Sheds and Bays 6, 7, 8, and 9.

Photo 3. Center of SIUF, near the Main Gate.

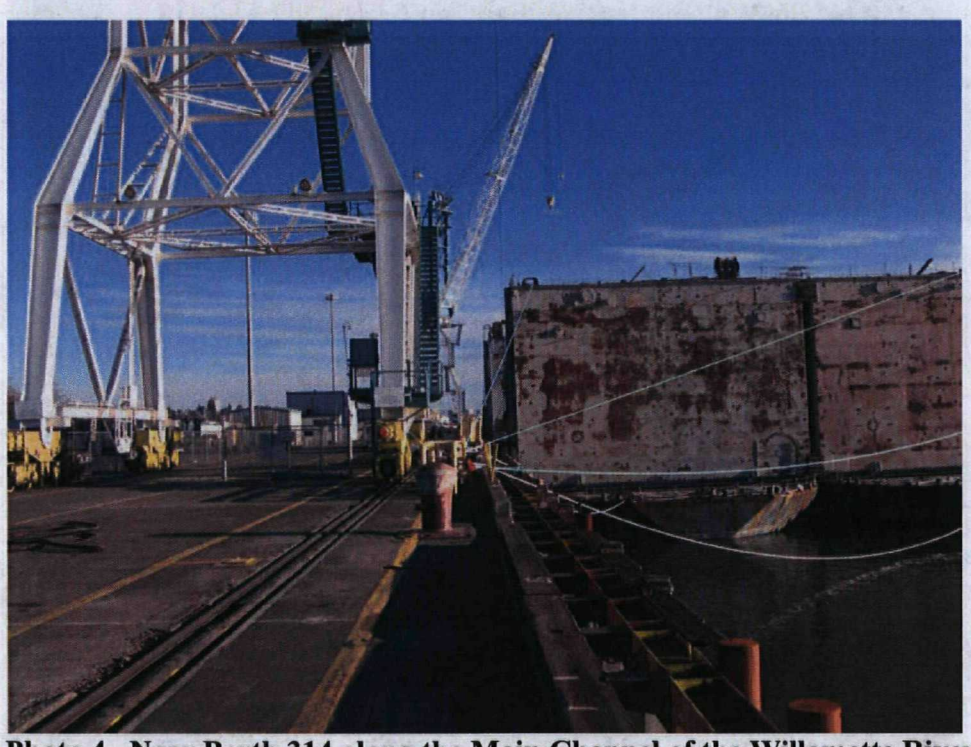


Photo 4. Near Berth 314 along the Main Channel of the Willamette River.

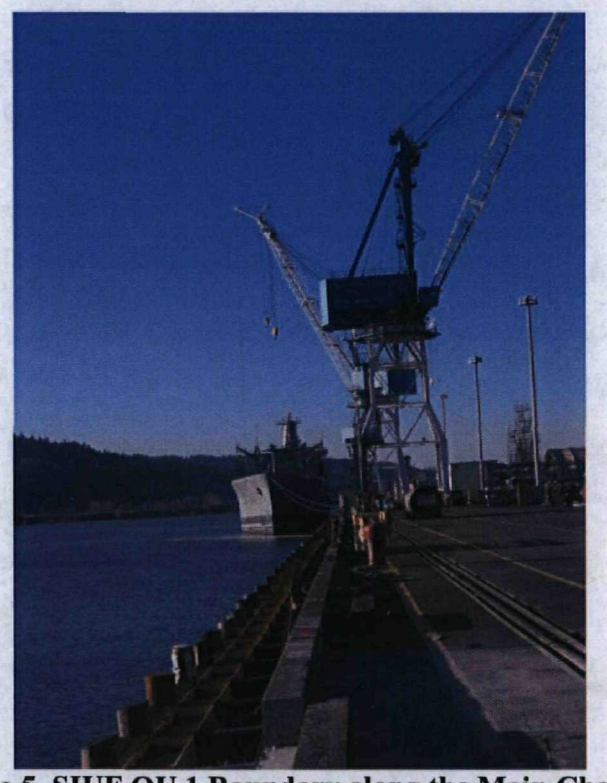


Photo 5. SIUF OU 1 Boundary along the Main Channel of the Willamette River between Berths 312 and 313.

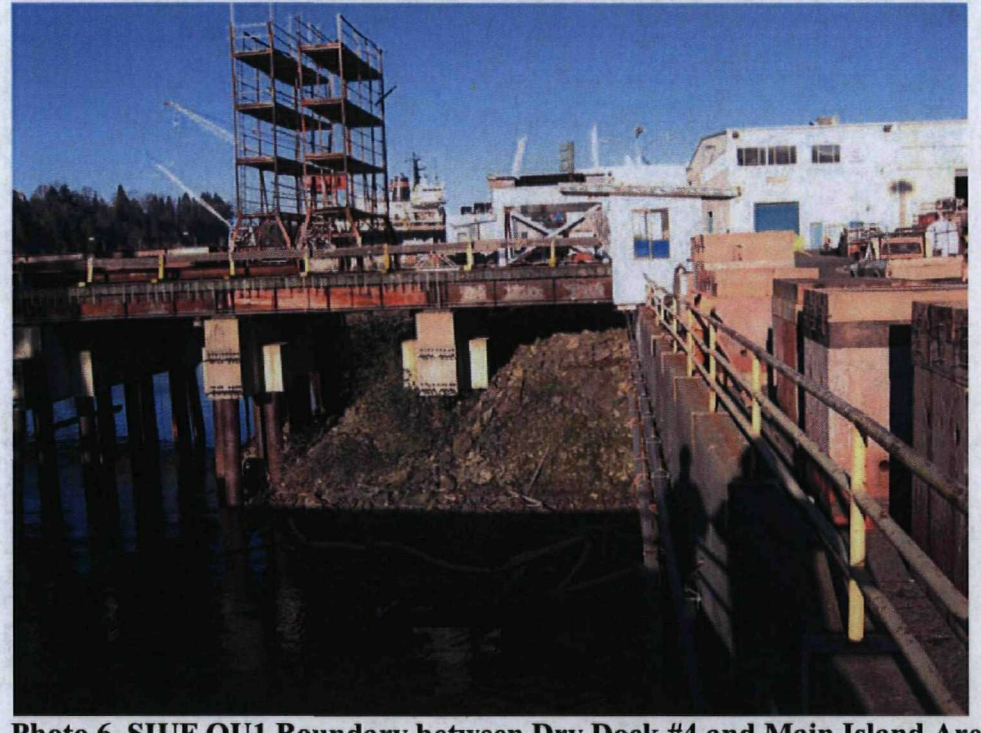


Photo 6. SIUF OU1 Boundary between Dry Dock #4 and Main Island Area.

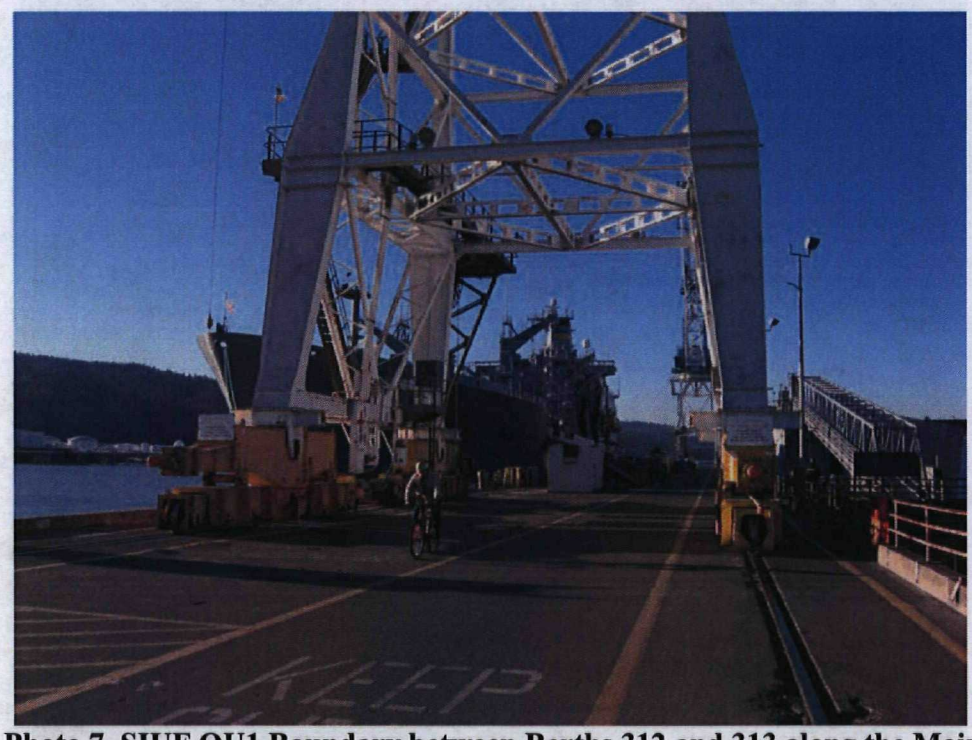


Photo 7. SIUF OU1 Boundary between Berths 312 and 313 along the Main Channel of the Willamette River.

Photo 8. SIUF OU1 Boundary between Dry Dock #4 and Main Island Area.

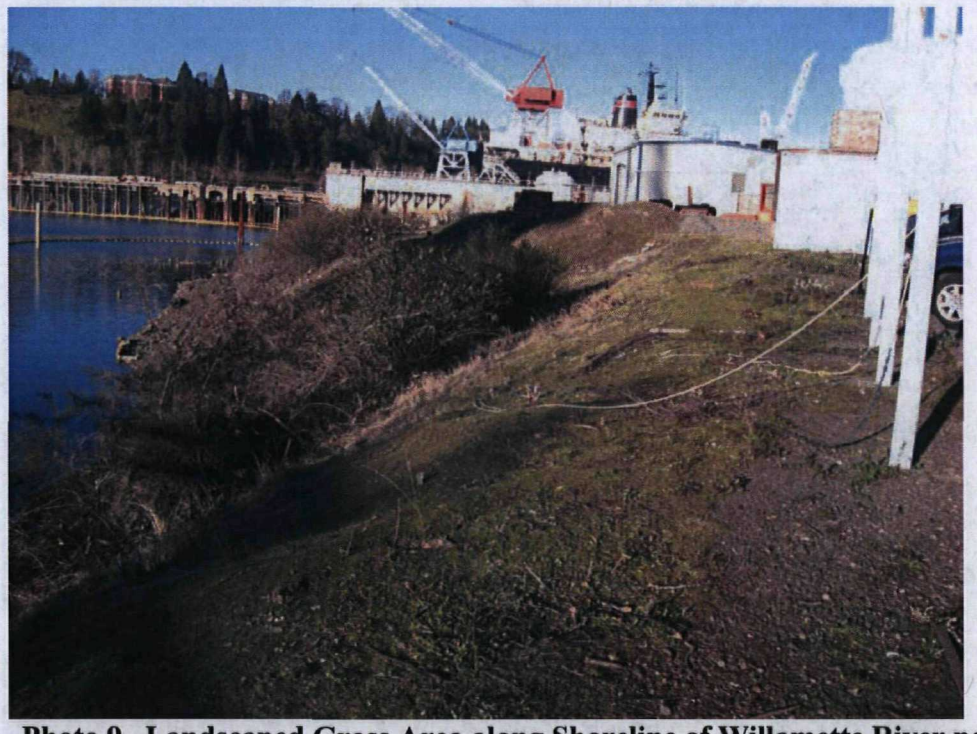


Photo 9. Landscaped Grass Area along Shoreline of Willamette River near the Ballast Water Treatment Plant.

Photo 10. Landscaped Grass Area and Ruderal Vegetation along Western Shoreline near Ballast Water Treatment Plant.

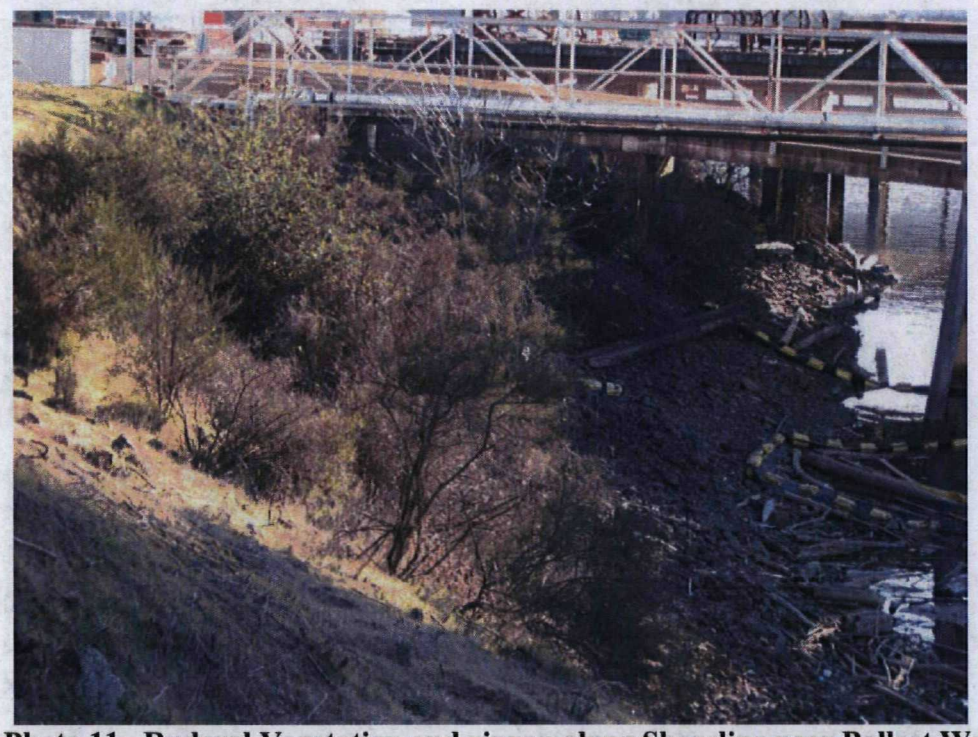


Photo 11. Ruderal Vegetation and riprap along Shoreline near Ballast Water Treatment Plant.

Photo 12. Landscaped Grass Area above Shrubs along Shoreline just Northeast of the Ballast Water Treatment Plant.

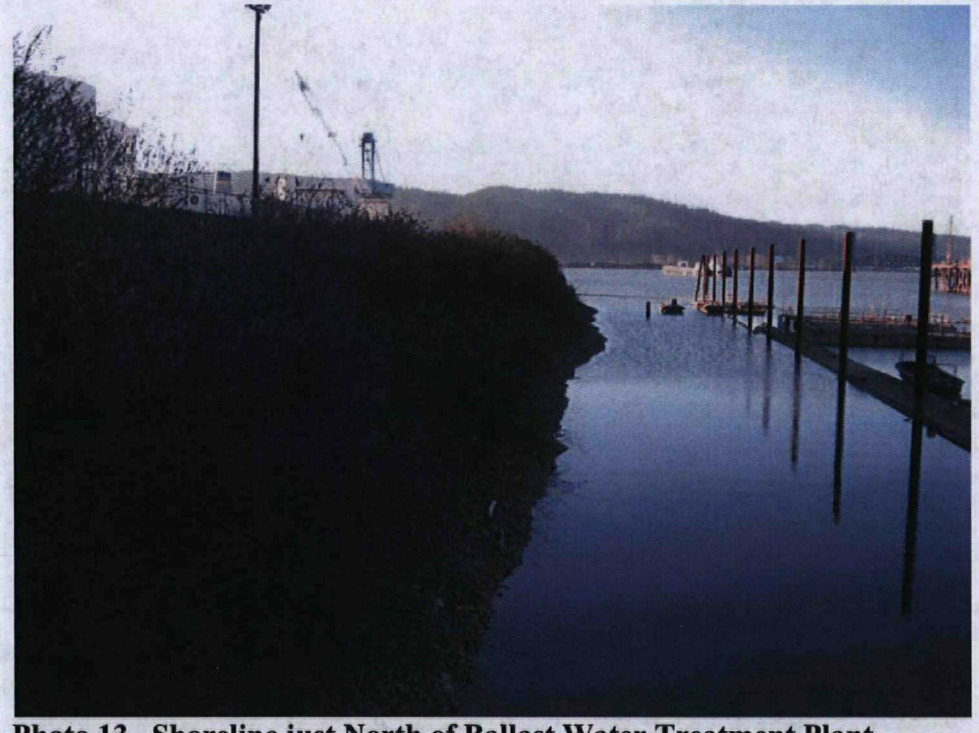


Photo 13. Shoreline just North of Ballast Water Treatment Plant.

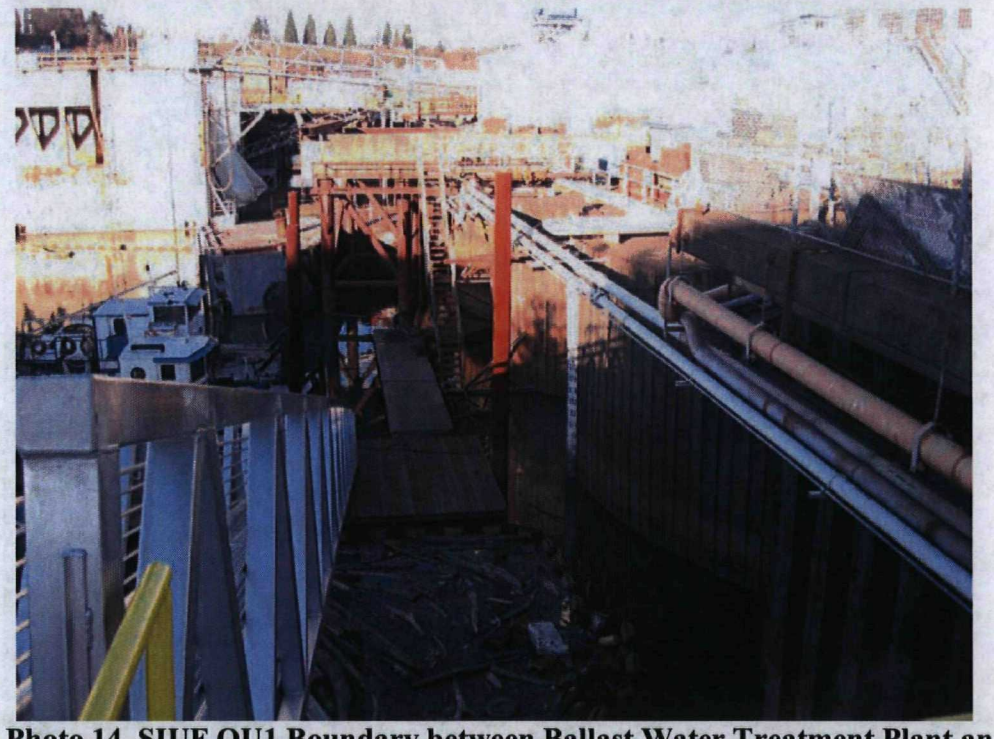


Photo 14. SIUF OU1 Boundary between Ballast Water Treatment Plant and Dry Dock #3.

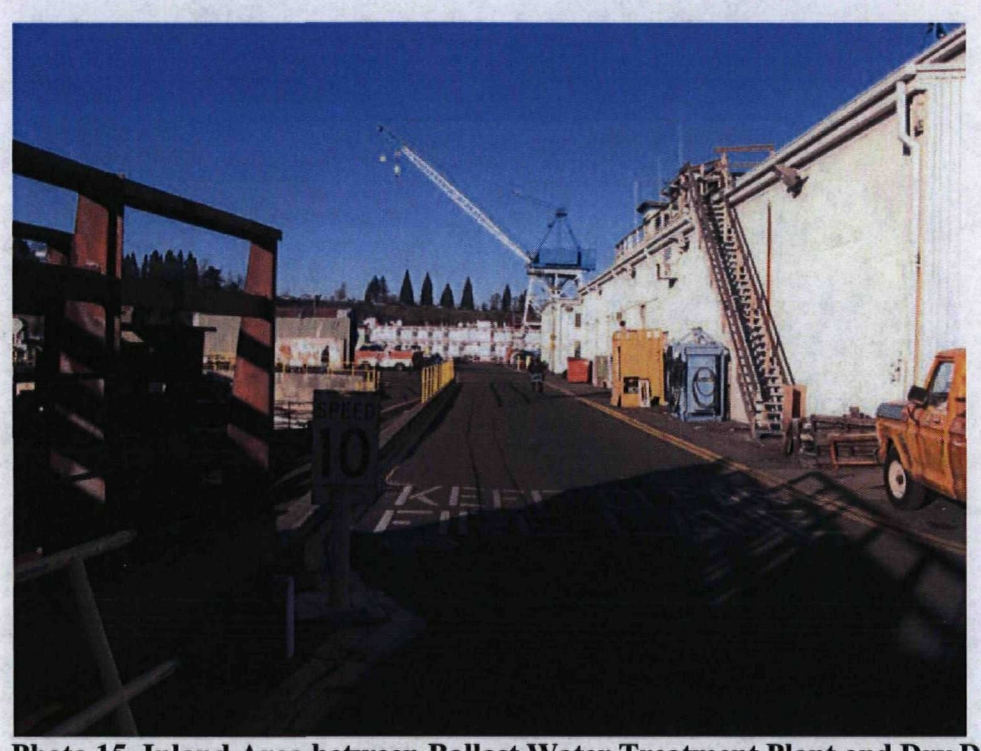


Photo 15. Inland Area between Ballast Water Treatment Plant and Dry Dock #3.

Photo 16. Shoreline between Berths 305 and 306 Adjacent to Steelhead.

Photo 17. Ruderal Vegetation along Shoreline between Berths 305 and 306 Adjacent to Steelhead.

ATTACHMENT 2

Ecological Scoping Checklist for Operable Unit 1, Swan Island Upland Facility

Oregon Department of Environmental Quality
GUIDANCE FOR ECOLOGICAL RISK ASSESSMENT
LEVEL I – SCOPING

ATTACHMENT 2
Ecological Scoping Checklist

Site Name	Swan Island Upland Facility (OU1)
Date of Site Visit	January 2008
Site Location	Swan Island, Portland, OR, 97217
Site Visit Conducted by	Mark Lewis, NewFields Boulder

Part 1

CONTAMINANTS OF INTEREST Types, Classes, Or Specific Hazardous Substances ‡ Known Or Suspected	Onsite	Adjacent to or in locality of the facility †
Total petroleum hydrocarbons (TPH)	X	
Polynuclear aromatic hydrocarbons (PAHs)	X	
Polychorinated biphenyls (PCBs)	X	
Volatile organic compounds (VOCs)	X	
Metals	X	

‡ As defined by OAR 340-122-115(30) † As defined by OAR 340-122-115(34)

Part 2

OBSERVED IMPACTS ASSOCIATED WITH THE SITE	Finding
Onsite vegetation (None, Limited, Extensive)	None (no effects attributable to chemical toxicity)
Vegetation in the locality of the site (None, Limited, Extensive)	Limited
Onsite wildlife such as macroinvertebrates, reptiles, amphibians, birds, mammals, other (None, Limited, Extensive)	Limited
Wildlife such as macroinvertebrates, reptiles, amphibians, birds, mammals, other in the locality of the site (None, Limited, Extensive)	Limited
Other readily observable impacts (None, Discuss below)	None
Discussion: Over 97% of the land cover at OU1 is comprised of buildings, structures, paved surfaces, gravel, riprap, etc. Industrial development in the vicinity significantly limits the habitat potential of this facility. Vegetation is characterized as extremely limited, confined to narrow marginal strips and predominately comprised of ruderal species. Wildlife observed onsite was limited to approximately 5 Canada geese. Offsite wildlife in the vicinity was limited to double-breasted cormorants and gulls resting on floating objects in the river offshore of the site.	

ATTACHMENT 2
Ecological Scoping Checklist (cont'd)

Part 3

SPECIFIC EVALUATION OF ECOLOGICAL RECEPTORS / HABITAT	Finding
Terrestrial - Wooded	
Percentage of site that is wooded ***NOTE: this habitat is only found as planted landscape trees**	<1%
Dominant vegetation type (Evergreen, Deciduous, Mixed)	D
Prominent tree size at breast height, i.e., four feet (<6", 6" to 12", >12")	> 12"
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	None observed
Terrestrial - Scrub/Shrub/Grasses	
Percentage of site that is scrub/shrub. ***NOTE: this habitat is only found in two small riverbank areas**	~2%
Dominant vegetation type (Scrub, Shrub, Grasses, Other)	Sc
Prominent height of vegetation (<2', 2' to 5', >5')	2'-5' on riverbank
Density of vegetation (Dense, Patchy, Sparse)	S or absent on upland; D on riverbank
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	None observed
Terrestrial - Ruderal	
Percentage of site that is ruderal ***NOTE: the majority of the site (at least 97%) is developed/paved, with sparse ruderal, weedy vegetation at road edges**	97%
Dominant vegetation type (Landscaped, Agriculture, Bare ground)	B (paved, gravel, riprap, structures)
Prominent height of vegetation (0', >0' to <2', 2' to 5', >5')	>0' to <2'
Density of vegetation (Dense, Patchy, Sparse)	S on upland
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	None observed
Aquatic - Non-flowing (lentic)	
Percentage of site that is covered by lakes or ponds	0%
Type of water bodies (Lakes, Ponds, Vernal pools, Impoundments, Lagoon, Reservoir, Canal)	N/A
Size (acres), average depth (feet), trophic status of water bodies	N/A
Source water (River, Stream, Groundwater, Industrial discharge, Surface water runoff)	N/A
Water discharge point (None, River, Stream, Groundwater, Wetlands impoundment)	N/A
Nature of bottom (Muddy, Rocky, Sand, Concrete, Other)	N/A
Vegetation present (Submerged, Emergent, Floating)	N/A
Obvious wetlands present (Yes / No)	N/A
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	N/A
Aquatic - Flowing (lotic)	
Percentage of site that is covered by rivers, streams (brooks, creeks), intermittent streams, dry wash, arroyo, ditches, or channel waterway. ***NOTE: No permanent waterbody other than Willamette River, which is adjacent to Operable Unit 1.**	0%

ATTACHMENT 2
Ecological Scoping Checklist (cont'd)

Type of water bodies (**R**ivers, **S**treams, **I**ntermittent Streams, **D**ry wash, **A**rroyo, **D**itches, **C**hannel waterway)	N/A
Size (acres), average depth (feet), approximate flow rate (cfs) of water bodies	N/A
Bank environment (cover: **V**egetated, **B**are / slope: **S**teep, **G**radual / height (in feet))	N/A
Source water (**R**iver, **S**tream, **G**roundwater, **I**ndustrial discharge, **S**urface water runoff)	N/A
Tidal influence (**Y**es / **N**o)	N/A
Water discharge point (**N**one, **R**iver, **S**tream, **G**roundwater, **W**etlands impoundment)	N/A
Nature of bottom (**M**uddy, **R**ocky, **S**and, **C**oncrete, **O**ther)	N/A
Vegetation present (**S**ubmerged, **E**mergent, **F**loating)	N/A
Obvious wetlands present (**Y**es / **N**o)	N/A
Evidence / observation of wildlife (**M**acroinvertebrates, **R**eptiles, **A**mphibians, **B**irds,	N/A
Mammals, **O**ther)	N/A
Aquatic - Wetlands	
Obvious or designated wetlands present (**Y**es / **N**o)	No
Wetlands suspected as site is/has (**A**djacent to water body, in **F**loodplain, **S**tanding water, **D**ark wet soils, **M**ud cracks, **D**ebris line, **W**ater marks)	N/A
Vegetation present (**S**ubmerged, **E**mergent, **S**crub/shrub, **W**ooded)	N/A
Size (acres) and depth (feet) of suspected wetlands	N/A
Source water (**R**iver, **S**tream, **G**roundwater, **I**ndustrial discharge, **S**urface water runoff)	N/A
Water discharge point (**N**one, **R**iver, **S**tream, **G**roundwater, **I**mpoundment)	N/A
Tidal influence (**Y**es / **N**o)	N/A
Evidence / observation of wildlife (**M**acroinvertebrates, **R**eptiles, **A**mphibians, **B**irds, **M**ammals, **O**ther)	N/A

* **P**: Photographic documentation of these features is highly recommended.

ECOLOGICALLY IMPORTANT SPECIES / HABITATS OBSERVED
Industrial development in the site vicinity significantly limits the habitat potential of this facility. The upland area will continue to be used for industrial purposes. No ecologically important habitats are observed at OU1. Over 97% of the land cover at OU1 is comprised of buildings, structures, paved surfaces, gravel, riprap, etc. Vegetation is characterized as extremely limited. There is a very small amount of sparse ruderal vegetation along roads, and a few planted trees. There are a few small, narrow riverbank areas where Himalayan blackberry and other weedy vegetation is growing through the riprap. The areas with small amounts of vegetation have limited habitat value because they are small, surrounded by paved areas or structures, distant from any other vegetated areas, and there are significant barriers and lack of any corridor to provide wildlife cover during travel. Any wildlife use would be intermittent. OU1 does not and will not provide suitable habitat for ecological receptors because of former, current, and likely future uses of the property.

ATTACHMENT 3

Evaluation of Receptor-Pathway Interactions for Operable Unit 1, Swan Island Upland Facility

ATTACHMENT 3
Evaluation of Receptor-Pathway Interactions

EVALUATION OF RECEPTOR-PATHWAY INTERACTIONS	Y	N	U
Are hazardous substances present or potentially present in surface waters? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via surface water?**		X	
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in surface waters. • Ability of hazardous substances to migrate to surface waters. • Terrestrial organisms may be dermally exposed to water-borne contaminants as a result of wading or swimming in contaminated waters. Aquatic receptors may be exposed through osmotic exchange, respiration or ventilation of surface waters. • Contaminants may be taken-up by terrestrial plants whose roots are in contact with surface waters. • Terrestrial receptors may ingest water-borne contaminants if contaminated surface waters are used as a drinking water source.	There are no ecologically important species or habitats present. There is no on-site surface water. *		
Notes: In accordance with ODEQ policy for the Portland Harbor, risk assessments for upland facilities will not include receptors or pathways in the Willamette River. There are no onsite surface water bodies or aquatic habitat, and consequently, no exposure to surface water.			
Are hazardous substances present or potentially present in groundwater? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via groundwater?**		X	
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in groundwater. • Ability of hazardous substances to migrate to groundwater. • Potential for hazardous substances to migrate via groundwater and discharge into habitats and/or surface waters. • Contaminants may be taken-up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone (1m depth). • Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.	There are no ecologically important species or habitats present. *		

Notes: * There is no exposure to terrestrial/upland receptors. Surface water/ groundwater could be transported to the Willamette River; any potential exposure to in-water receptors is being evaluated separately. Groundwater is at least 18 feet below ground surface and contaminants have not been detected at concentrations exceeding ecological screening levels. As a result, exposure of terrestrial receptors to site-specific contaminants on the upland or riverbank areas is unlikely.

"Y" = yes; "N" = No, "U" = Unknown (counts as a "Y")

ATTACHMENT 3
Evaluation of Receptor-Pathway Interactions (cont'd)

EVALUATION OF RECEPTOR-PATHWAY INTERACTIONS	Y	N	U
Are hazardous substances present or potentially present in sediments? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via contact with sediments?**		X	
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in sediment. • Ability of hazardous substances to leach or erode from surface soils and be carried into sediment via surface runoff. • Potential for contaminated groundwater to upwell through, and deposit contaminants in, sediments. • If sediments are present in an area that is only periodically inundated with water, terrestrial species may be dermally exposed during dry periods. Aquatic receptors may be directly exposed to sediments or may be exposed through osmotic exchange, respiration or ventilation of sediment pore waters. • Terrestrial plants may be exposed to sediment in an area that is only periodically inundated with water. • If sediments are present in an area that is only periodically inundated with water, terrestrial species may have direct access to sediments for the purposes of incidental ingestion. Aquatic receptors may regularly or incidentally ingest sediment while foraging.	There are no ecologically important species or habitats present. There are no on-site sediments.		
Notes: In accordance with ODEQ policy for the Portland Harbor, risk assessments for upland facilities will not include receptors or pathways in the Willamette River. There are no onsite surface water bodies, and subsequently no sediments to which ecological receptors would be exposed.			
Are hazardous substances present or potentially present in prey or food items of ecologically important receptors? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via consumption of food items?**		X	
When answering the above questions, consider the following: • Higher trophic level terrestrial and aquatic consumers and predators may be exposed through consumption of contaminated food sources. • In general, organic contaminants with log Kow > 3.5 may accumulate in terrestrial mammals and those with a log Kow > 5 may accumulate in aquatic vertebrates.	There are no ecologically important species or habitats present.		

"Y" = yes; "N" = No, "U" = Unknown (counts as a "Y")

ATTACHMENT 3
Evaluation of Receptor-Pathway Interactions (cont'd)

EVALUATION OF RECEPTOR-PATHWAY INTERACTIONS	Y	N	U
Are hazardous substances present or potentially present in surficial soils? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via incidental ingestion of or dermal contact with surficial soils?**		X	
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in surficial (1m depth) soils. • Ability of hazardous substances to migrate to surficial soils. • Significant exposure via dermal contact would generally be limited to organic contaminants which are lipophilic and can cross epidermal barriers. • Exposure of terrestrial plants to contaminants present in particulates deposited on leaf and stem surfaces by rain striking contaminated soils (i.e., rain splash). • Contaminants in bulk soil may partition into soil solution, making them available to roots. Incidental ingestion of contaminated soil could occur while animals grub for food resident in the soil, feed on plant matter covered with contaminated soil or while grooming themselves clean of soil.	There are no ecologically important species or habitats present. Soils are largely covered by paved surfaces and gravel.		
Are hazardous substances present or potentially present in soils? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via vapors or fugitive dust carried in surface air or confined in burrows?**		X	
When answering the above questions, consider the following: • Volatility of the hazardous substance (volatile chemicals generally have Henry's Law constant > 10-5 atm-m3/mol and molecular weight < 200 g/mol). • Exposure via inhalation is most important to organisms that burrow in contaminated soils, given the limited amounts of air present to dilute vapors and an absence of air movement to disperse gases. • Exposure via inhalation of fugitive dust is particularly applicable to ground-dwelling species that could be exposed to dust disturbed by their foraging or burrowing activities or by wind movement. • Foliar uptake of organic vapors would be limited to those contaminants with relatively high vapor pressures. • Exposure of terrestrial plants to contaminants present in particulates deposited on leaf and stem surfaces.	There are no ecologically important species or habitats present. Soils are largely covered by paved surfaces and gravel.		

"Y" = yes; "N" = No, "U" = Unknown (counts as a "Y")

ATTACHMENT 4

Oregon Natural Heritage Information Center
Species of Special Interest
for Operable Unit 1, Swan Island Upland Facility

Attachment 4

Oregon Natural Heritage Information Center Species of Special Interest for Operable Unit 1, Swan Island Upland Facility

Common Name	Scientific Name	Federal Status	State Status
Plants			
Tall bugbane	*Cimicifuga elata*	-	C
Fish [1]			
Green sturgeon	*Acipenser medirostris*	SOC	-
Steelhead (Lower Columbia River ESU, winter run)	*Oncorhynchus mykiss* pop. 27	LT	SC
Chinook salmon (Lower Columbia River ESU, spring run)	*Oncorhynchus tshawytscha* pop. 21	LT	SC
Chinook salmon (Lower Columbia River ESU, fall run)	*Oncorhynchus tshawytscha* pop. 22	LT	SC
Coho salmon (Lower Columbia River/SW Washington Coast ESU)	*Oncorhynchus kisutch* pop. 1	PT	LE
Birds			
American peregrine falcon	*Falco peregrinus annatum*	-	LE
Yellow-billed cuckoo	*Coccyzus americanus*	C	SC
Tricolored blackbird	*Agelaius tricolor*	SOC	SP
Reptiles/Amphibians			
Painted turtle	*Chrysemys picta belli*	-	SC
Mammals			
Townsend's big-eared bat	*Corynorhinus townsendii*	SOC	SC

Notes:

[1]The Upland Facility does not contain aquatic habitats. Fish are included only because of potentially complete pathways to the Willamette River.

Source: Confidential analysis of rare, threatened and endangered species provided by Oregon Natural Heritage Information Center.

LE - listed endangered

E - endangered

SC or C - sensitive, critical

SP - sensitive-peripheral

SOC - species of concern

LT - listed threatened

APPENDIX C
Riverbank Area Surface Soil Sampling Results Memorandum

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

Memorandum

Date: March 11, 2010

To: Mr. Kelly Madalinski, Port of Portland

From: Michael Pickering

Re: Surface Soil Sampling Results - Ballast Water Treatment Plant, Operable Unit 1
Swan Island Upland Facility
Portland, Oregon
ECSI No. 271
1115-06

This memorandum provides the results of surface soil sampling activities completed to support the preparation of a Level II Ecological Risk Assessment (ERA) for Operable Unit 1 (the Facility or OU1) at the Swan Island Upland Facility (SIUF) in Portland, Oregon (Figures 1 and 2). The Port of Portland (Port) is under a Voluntary Cleanup Program (VCP) Agreement with the Oregon Department of Environmental Quality (DEQ) for Remedial Investigation (RI), Source Control Measures (SCMs), and Feasibility Study (FS) at the Facility (dated July 24, 2006). The work was completed in accordance with a Work Plan (Ash Creek, 2009) that was approved by the DEQ (DEQ, 2009). The methods, procedures, and results of the chemical analyses are presented in this memorandum.

PREPARATORY ACTIVITIES

The following activities and schedule coordination were completed in preparation for the field work.

- **Health and Safety Plan (HASP).** Ash Creek Associates (Ash Creek) prepared a HASP for its personnel involved with the project.
- **Underground Utility Location.** An underground utility locate was conducted prior to the sampling activities.
- **Work Off Port Property.** The work activities in OU1 were conducted in coordination with Vigor Industrial schedules.

SURFACE SOIL SAMPLING

Surface soil was collected from a depth of 0 to 1 foot at the twelve discrete sub-sample locations (Figure 3) in accordance with Standard Operating Procedure (SOP)-2.2 (Attachment A). Each soil sample was field-screened for volatile organic compounds (VOCs) using a photoionization detector (PID) and for the presence of petroleum hydrocarbons using a sheen test in accordance with SOP 2.1 (Attachment A). No field indications of VOCs or petroleum hydrocarbons were observed. (Attachment A).

Location Control. The sample locations were recorded using a high-accuracy, handheld global positioning system (GPS) device (Trimble© GeoXH™).

CHEMICAL ANALYSES

The soil samples collected from the above activities were submitted to TestAmerica in Beaverton, Oregon for chemical analysis. Copies of the laboratory reports are included in Attachment B (CD-ROM). A quality assurance review of the data was completed. No qualifiers were attached to the data as a result of our review.

The soil samples were submitted for chemical analyses for the following Constituents of Interest (COIs) identified in the Level I ERA:

- Diesel- and oil-range total petroleum hydrocarbons (TPH) by Northwest Method NWTPH-Dx (with silica gel cleanup);
- Polychlorinated biphenyls (PCBs) by EPA Method 8082 (Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, and 1268);
- Polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270-SIM;
- Metals by EPA 6000/7000 Series Methods (including antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc); and
- Tributyltin (TBT) by the Krone Method.

The analytical laboratory results are presented in Table 1.

REFERENCES

Ash Creek, 2009. Proposed Surface Soil Sampling - Ballast Water Treatment Plant, Operable Unit 1, Swan Island Upland Facility, Portland, Oregon, ECSI No. 271. July 22, 2009.

DEQ, 2009. Swan Island Upland Facility, Operable Unit 1 Proposed Surface Soil Sampling for Level II Ecological Risk Assessment, ECSI No. 271. September 17, 2009.

ATTACHMENTS:

Table 1 – Soil Analytical Results: TPH

Figure 1 – Facility Location Map
Figure 2 – Facility Plan
Figure 3 – Sample Location Plan

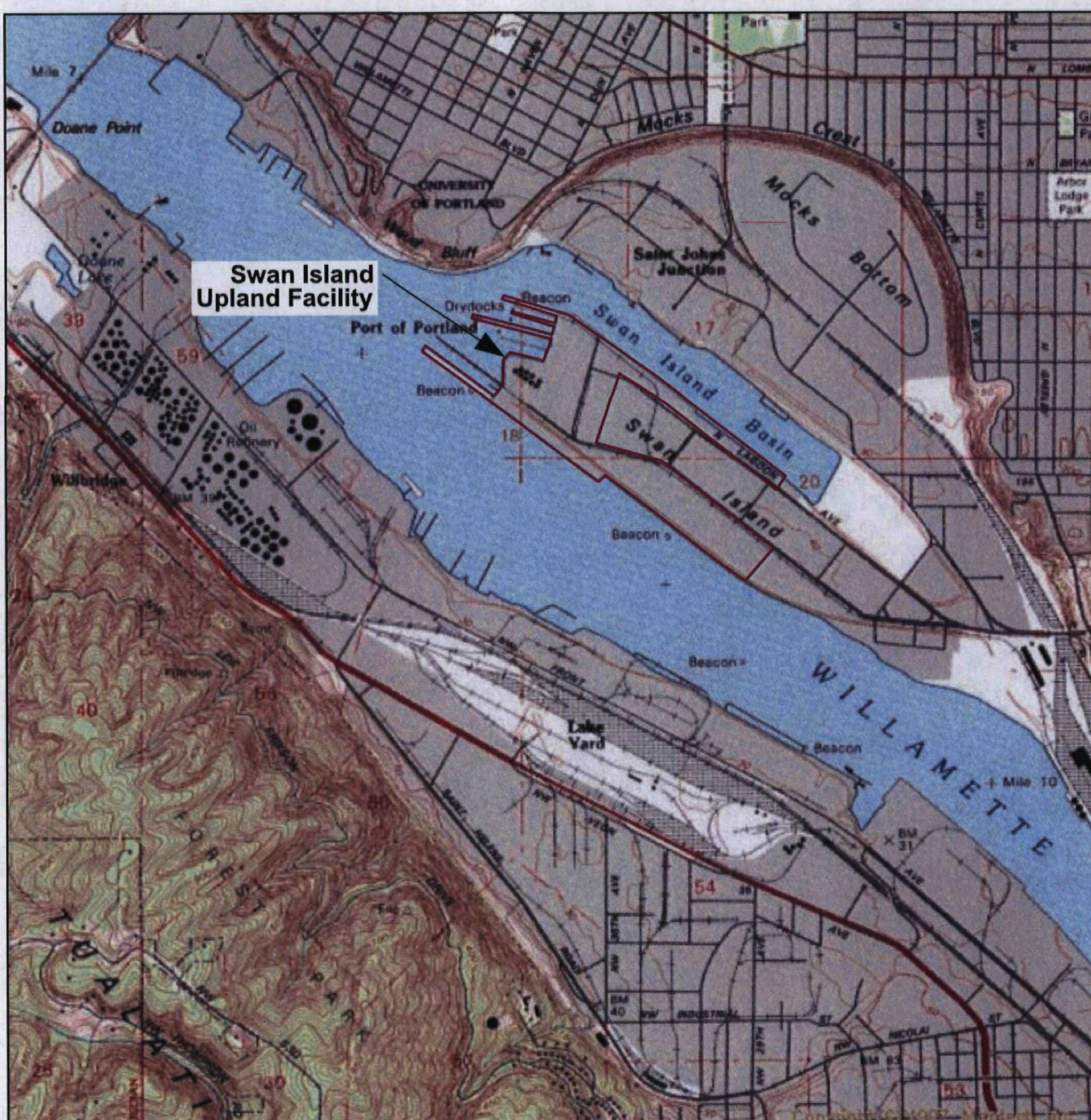
Attachment A – Standard Operating Procedures 2.1 and 2.2
Attachment B – Analytical Laboratory Report

Table 1
Swan Island Upland Facility, OU1
Portland, Oregon

Sample ID:	SS-OU1-BWTP-01	SS-OU1-BWTP-02	SS-OU1-BWTP-03	SS-OU1-BWTP-04	SS-OU1-BWTP-05	SS-OU1-BWTP-06	SS-OU1-BWTP-07	SS-OU1-BWTP-08	SS-OU1-BWTP-09	SS-OU1-BWTP-10	SS-OU1-BWTP-11	SS-OU1-BWTP-12
Date:	10/16/2009	10/16/2009	10/16/2009	10/16/2009	10/16/2009	10/16/2009	10/16/2009	10/16/2009	10/16/2009	10/16/2009	10/16/2009	10/16/2009
NWTPH-Dx (mg/kg)												
Diesel-Range Organics	<13.3	<13.3	<13.5	<14.1	<13.1	<12.9	<13.5	<13.5	<13.6	<13.6	<13.6	**17.4**
Heavy Oil-Range Hydrocarbons	**34.8**	<26.6	<27.1	<28.2	<26.2	**45.5**	<26.9	<27.1	**30.8**	**45.2**	<27.2	**76.1**
Metals (mg/kg)												
Antimony	<0.515	**0.662**	**0.883**	**0.781**	**0.566**	**0.793**	<0.531	**0.611**	**0.556**	<0.537	**2.21**	**1.44**
Arsenic	**3.96**	**4.10**	**4.75**	**4.12**	**4.25**	**4.96**	**4.40**	**4.55**	**3.65**	**4.27**	**9.50**	**7.22**
Cadmium	<0.515	<0.521	<0.529	<0.550	<0.506	<0.502	<0.531	<0.518	<0.529	<0.537	<0.544	<0.528
Chromium	**18.5**	**20.9**	**25.9**	**13.6**	**25.7**	**28.2**	**30.6**	**24.2**	**16.9**	**24.4**	**38.5**	**23.1**
Copper	**75.3**	**91.4**	**126**	**138**	**137**	**136**	**114**	**109**	**97.6**	**77.9**	**229**	**189**
Lead	**27.6**	**25.9**	**33.9**	**31.8**	**34.7**	**38.6**	**29.3**	**30.4**	**19.4**	**26.2**	**28.0**	**30.6**
Nickel	**17.5**	**19.1**	**18.7**	**12.1**	**21.3**	**21.1**	**19.0**	**18.6**	**13.6**	**20.5**	**42.9**	**19.1**
Silver	<0.515	<0.521	<0.529	<0.550	<0.506	<0.502	<0.531	<0.518	<0.529	<0.537	<0.544	<0.528
Zinc	**96.6**	**117**	**124**	**180**	**122**	**150**	**137**	**123**	**110**	**110**	**193**	**194**
Mercury	**0.133**	<0.0976	**0.135**	<0.086	**0.104**	**0.123**	<0.0939	**0.103**	<0.0895	<0.0983	<0.0870	<0.0937
Polycyclic Aromatic Hydrocarbons (ug/kg)												
Acenaphthene	<14.3	<14.5	<14.5	<15.2	<14.2	<14.1	<14.5	<14.4	<14.5	<14.7	<14.7	<29.2
Acenaphthylene	**18.2**	<14.5	**142**	<15.2	<14.2	<14.1	<14.5	<14.4	<14.5	<14.7	**23.3**	<29.2
Anthracene	<14.3	<14.5	**41.6**	<15.2	<14.2	**20.6**	<14.5	<14.4	**20.2**	**15.5**	**19.5**	<29.2
Benz(a)anthracene	**26.3**	**71.0**	**72.7**	**39.0**	**39.8**	**74.0**	**43.6**	**46.3**	**101**	**66.6**	**79.8**	**75.3**
Benzo(a)pyrene	**41.2**	**73.4**	**273**	**54.6**	**55.9**	**93.6**	**58.4**	**59.4**	**122**	**94.9**	**133**	**99.2**
Benzo(b)fluoranthene	**39.6**	**90.4**	**220**	**62.0**	**62.8**	**111**	**64.0**	**59.5**	**116**	**95.7**	**117**	**98.4**
Benzo(g,h,i)perylene	**53.8**	**69.1**	**409**	**52.0**	**56.3**	**93.3**	**63.3**	**58.0**	**121**	**95.8**	**171**	**105**
Benzo(k)fluoranthene	**31.8**	**66.2**	**136**	**46.2**	**50.8**	**97.0**	**57.2**	**49.8**	**90.5**	**87.5**	**91.6**	**69.5**
Chrysene	**32.4**	**86.5**	**92.4**	**52.1**	**49.3**	**95.9**	**56.4**	**56.2**	**120**	**82.1**	**106**	**92.7**
Dibenz(a,h)anthracene	<14.3	**19.3**	**85.1**	<15.2	**15.3**	**26.5**	**16.4**	**15.2**	**27.4**	**24.4**	**27.0**	<29.2
Fluoranthene	**41.6**	**111**	**104**	**82.4**	**62.6**	**143**	**77.7**	**92.5**	**181**	**115**	**170**	**132**
Fluorene	<14.3	<14.5	<14.5	<15.2	<14.2	<14.1	<14.5	<14.4	<14.5	<14.7	<14.7	<29.2
Indeno(1,2,3-cd)pyrene	**39.4**	**59.3**	**331**	**44.2**	**48.2**	**83.7**	**51.3**	**48.9**	**95.9**	**80.8**	**122**	**84.8**
Naphthalene	<14.3	<14.5	<14.5	<15.2	<14.2	<14.1	<14.5	<14.4	<14.5	<14.7	<14.7	<29.2
Phenanthrene	**15.3**	**35.7**	**30.4**	**48.5**	**30.2**	**94.1**	**44.0**	**68.9**	**76.0**	**64.3**	**78.5**	**67.6**
Pyrene	**49.8**	**105**	**132**	**81.2**	**65.1**	**129**	**80.6**	**91.0**	**187**	**119**	**217**	**146**
Polychlorinated Biphenyls (ug/kg)												
Aroclor 1016	<35.5	<36.0	<36.2	<37.8	<35.0	<34.6	<35.9	<71.9	<36.0	<36.4	<36.6	<36.5
Aroclor 1221	<71.5	<72.5	<72.8	<76.0	<70.4	<69.6	<72.2	<145	<72.4	<73.2	<73.6	<73.5
Aroclor 1232	<35.5	<36.0	<36.2	<37.8	<35.0	<34.6	<35.9	<71.9	<36.0	<36.4	<36.6	<36.5
Aroclor 1242	<35.5	<36.0	<36.2	<37.8	<35.0	<34.6	<35.9	<71.9	<36.0	<36.4	<36.6	<36.5
Aroclor 1248	<35.5	<36.0	<36.2	<37.8	<35.0	<34.6	<35.9	<71.9	<36.0	<36.4	<36.6	<36.5
Aroclor 1254	<35.5	<36.0	<36.2	<37.8	<35.0	<34.6	<35.9	<71.9	<36.0	<36.4	<36.6	<36.5
Aroclor 1260	**166**	**162**	**224**	**43**	**257**	**93.7**	**387**	**424**	**228**	**114**	**225**	**92.6**
Aroclor 1262	<35.5	<36.0	<36.2	<37.8	<35.0	<34.6	<35.9	<71.9	<36.0	<36.4	<36.6	<36.5
Aroclor 1268	<35.5	<36.0	<36.2	<37.8	<35.0	<34.6	<35.9	<71.9	<36.0	<36.4	<36.6	<36.5
TBT (ug/kg)												
Tributyltin (TBT)	**18**	**970**	**60**	**550**	**240**	**520**	**500**	**280**	**1,700**	**3,800**	**190**	**2,500**

Notes:

1. µg/kg (ppb) = Micrograms per kilogram (parts per billion).
2. mg/kg (ppm) = Milligrams per kilogram (parts per million).
3. < = Not detected above the method reporting limit (MRL)
4. **Bold** = Detected concentration



Base map prepared from USGS 7.5-minute quadrangles as provided by Topozone. (1990)

N

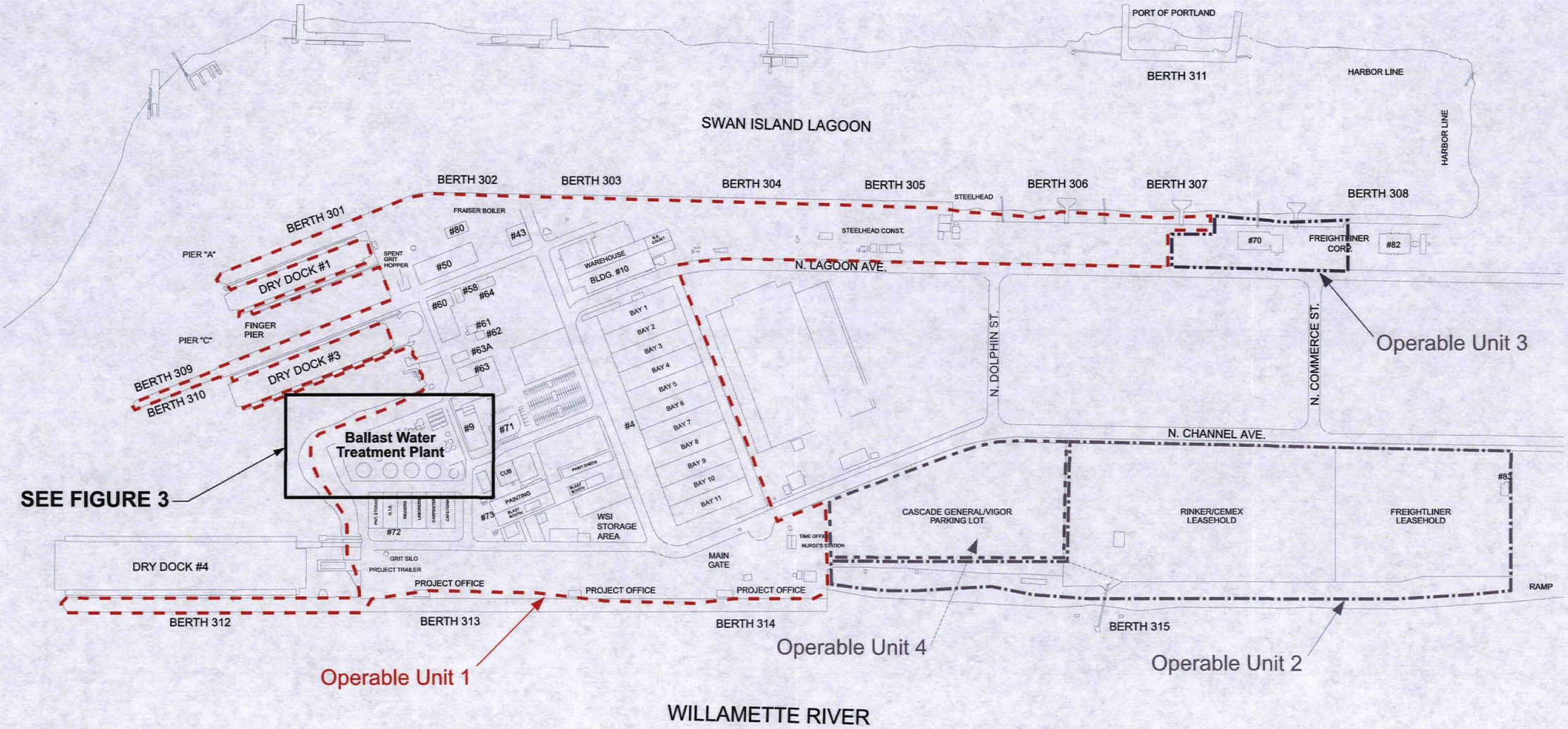
0 2,000 4,000

Approximate Scale in Feet

Facility Location Map

Surface Soil Sampling Letter
Swan Island Upland Facility Operable Unit 1
Portland, Oregon

Ash Creek Associates, Inc. Environmental and Geotechnical Consultants	Project Number	1115-06	Figure
	March 2010		1



Legend:

- Operable Unit 1 Boundary
- Operable Unit 2 Boundary
- Operable Unit 3 Boundary
- Operable Unit 4 Boundary

0 400 800

Scale in Feet

Site Vicinity Map

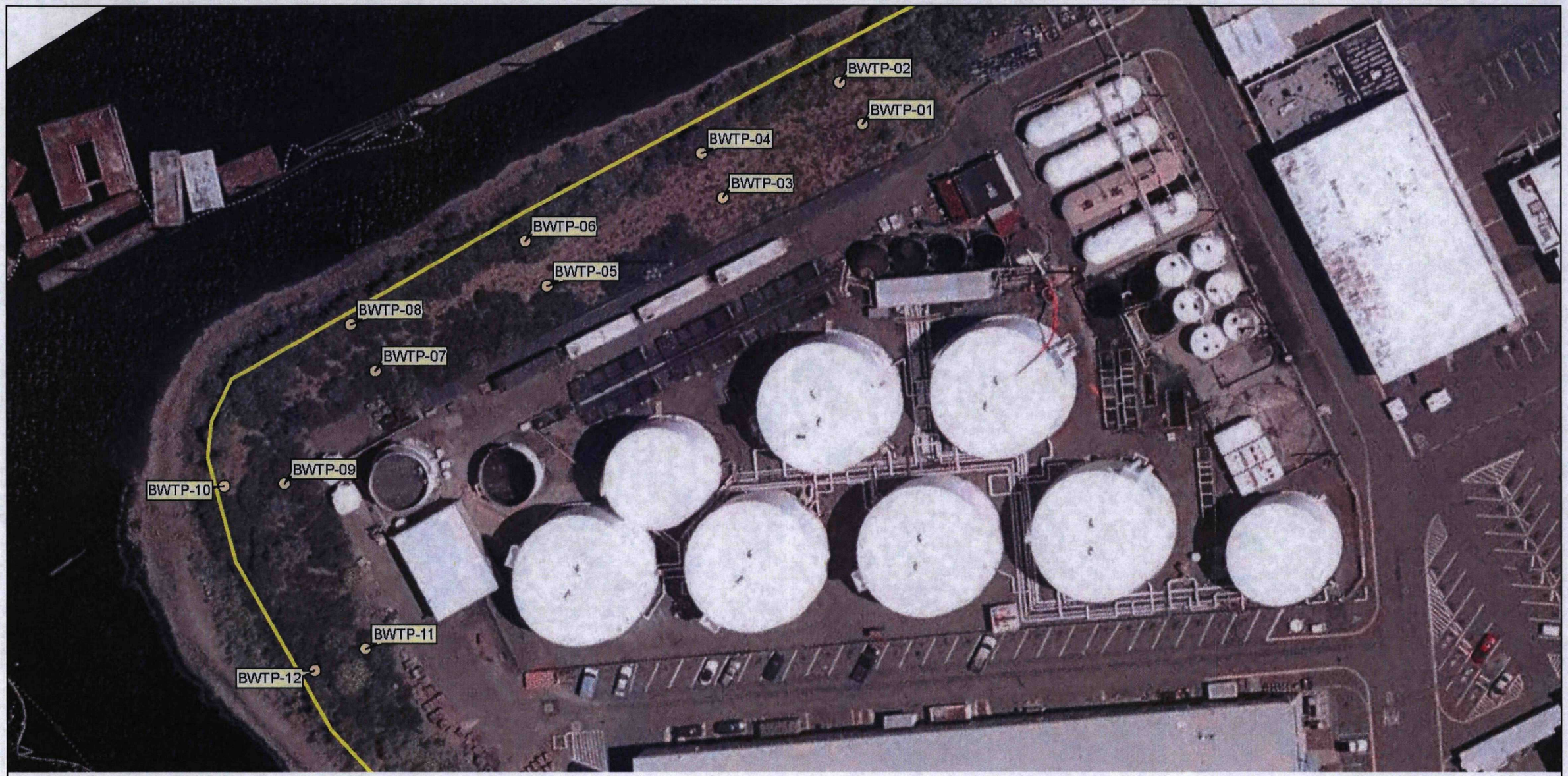
Surface Soil Sampling Letter
Swan Island Upland Facility Operable Unit 1
Portland, Oregon

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

Project Number 1115-06

March 2010

Figure 2



Legend:

Approximate Line of Ordinary High Water

Proposed Discrete Sample Location

N

0 50 100

Scale in Feet

Sample Location Plan

Surface Soil Sampling Letter
Swan Island Upland Facility Operable Unit 1
Portland, Oregon

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

Project Number 1115-06

March 2010

Figure 3

Attachment A

Standard Operating Procedures 2.1 and 2.2

STANDARD OPERATING PROCEDURE	SOP Number: 2.1
	Date: May 6, 2009
STANDARD FIELD SCREENING PROCEDURES	Revision Number: 1.01
	Page: 1 of 2

1. PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides instructions for standard field screening. Field screening results are used to aid in the selection of soil samples for chemical analysis. This procedure is applicable during all Ash Creek Associates (ACA) soil sampling operations.

Standard field screening techniques include the use of a photoionization detector (PID) to assess for volatile organic compounds (VOCs), for the presence of petroleum hydrocarbons using a sheen test, and for non-aqueous phase liquids (NAPLs) using dyes and UV light. These methods will not detect all potential contaminants, so selection of screening techniques shall be based on an understanding of the site history. The PID is not compound or concentration-specific, but it can provide a qualitative indication of the presence of VOCs. PID measurements are affected by other field parameters such as temperature and soil moisture.

2. EQUIPMENT AND MATERIALS

The following materials are necessary for this procedure:

- PID with calibration gas (record daily calibration/calibration check in field notes)
- Glass jars (with aluminum foil) or resealable bags
- NAPL Dye (such as OilScreen DNAPL-Lens) if needed for NAPL screening
- UV Light Box (if needed for NAPL screening)

3. METHODOLOGY

Each soil sample will be field screened for VOCs using a PID (with a 10.2 eV probe) and for the presence of petroleum hydrocarbons using a sheen test. If the presence of NAPLs is suspected, then screening using dye and UV light is also to be completed. The PID used on site will be calibrated on a daily basis according to the manufacturer's specifications. The PID is also used as a safety tool. The PID can be used to monitor air during activities where vapors may be present in the breathing space. Document all calibration activities and field observations per SOP 1.1. The field screening procedures are summarized below.

PID Calibration Procedure:

- Zero the PID using ambient air from the general area where the work will be done.
- A standard gas of 100 ppm isobutylene gas is then used to calibrate the PID. If questionable readings are encountered, the PID will be recalibrated using new 100 ppm isobutylene gas.

PID Screening Procedure:

- Place a representative portion (approximately one ounce) of freshly exposed, uncompacted soil into a clean resealable plastic bag or glass jar.
- Seal the bag or jar (with aluminum foil) and shake to expose vapors from the soil matrix.
- Allow the bag to sit to reach ambient temperature.
- Carefully insert the intake port of the PID into the plastic bag or jar.
- Record the sample concentration in the field notes.

Sheen Test Procedure:

- Following the PID screen, add enough water to the bag/jar to cover the sample.
- Observe the water surface for signs of discoloration/sheen and characterize.

No Sheen (NS)	No visible sheen on the water surface
Slight Sheen (SS)	Light, colorless, dull sheen, irregular spread, not rapid. Biological content may produce a slight sheen (typically platy/blocky).
Moderate Sheen (MS)	Light to heavy coverage, may have some color/iridescence, spread is irregular to flowing, few remaining areas of no sheen on water surface.
Heavy Sheen (HS)	Heavy sheen coverage with color/iridescence, spread is rapid, entire water surface may be covered with sheen.

NAPL Dye Procedure:

- Dye can be either liquid form, dissolvable tablet, or spray applied.
- Follow manufacturers instructions for specific product used.
- NAPL testing is completed after other field screening and sample collection is complete.
- For OilScreen DANPL-Lens dye, the remaining soil sample is sprayed along its length so the soil surface is visibly wetted. A royal blue color of the dye about one minute after spraying would be considered a positive indication of NAPL.

UV Light Screening Procedure:

- UV Light Screening involves placement of a portion of the soil sample into a resealable plastic bag (which can be the same as used for PID screening, but before sheen test is performed).
- The sample was then examined in a dark space under UV light using a small, portable UV light box.
- The plastic bag is manipulated during examination to squeeze fluid against the bag beneath the lamp.
- Fluorescence (glowing color) indicates presence of NAPLs.

STANDARD OPERATING PROCEDURE	SOP Number: 2.2
	Date: December 11, 2007
SURFACE SOIL SAMPLING PROCEDURES	Revision Number: 0.01
	Page: 1 of 2

1. PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) describes the methods used for obtaining surface soil samples for physical and/or chemical analysis. For purposes of this SOP, surface soil (including shallow subsurface soil) is loosely defined as soil that is present within 3 feet of the ground surface at the time of sampling. Various types of sampling equipment are used to collect surface soil samples including spoons, scoops, trowels, shovels, and hand augers.

2. EQUIPMENT AND MATERIALS

The following materials are necessary for this procedure:

- Spoons, scoops, trowels, shovels, and/or hand augers. Stainless steel is preferred.
- Stainless steel bowls
- Laboratory-supplied sample containers
- Field documentation materials
- Decontamination materials
- Personal protective equipment (as required by Health and Safety Plan)

3. METHODOLOGY

Project-specific requirements will generally dictate the preferred type of sampling equipment used at a particular site. The following parameters should be considered: sampling depth, soil density, soil moisture, use of analyses (e.g., chemical versus physical testing), type of analyses (e.g., volatile versus non-volatile). Analytical testing requirements will indicate sample volume requirements that also will influence the selection of the appropriate type of sampling tool. The project sampling plan should define the specific requirements for collection of surface soil samples at a particular site.

Collection of Samples

- **Volatile Analyses.** Surface soil sampling for volatile organics analysis (VOA) is different than other routine physical or chemical testing because of the potential loss of volatiles during sampling. To limit volatile loss, the soil sample must be obtained as quickly and as directly as possible. If a VOA sample is to collected as part of a multiple analyte sample, the VOA sample portion will be obtained first. The VOA sample should be obtained from a discrete portion of the entire collected sample and should not be composited or homogenized. Sample bottles should be filled to capacity, with no headspace. Specific procedures for collecting VOA samples using the EPA Method 5035 are discussed in SOP 2-7.
- **Other Analyses.** Once the targeted sample interval has been collected, the soil sample will be thoroughly homogenized in a stainless steel bowl prior to bottling. Sample homogenizing is accomplished by manually mixing the entire soil sample in the stainless steel bowl with the sampling tool or with a clean teaspoon or spatula until a uniform mixture is achieved. If packing of the samples into the bottles is necessary, a clean stainless steel teaspoon or spatula may be used.

General Sampling Procedure:

- Decontaminate sampling equipment in accordance with the Sampling and Analysis Plan (SAP) before and after each individual soil sample.
- Remove surface debris that blocks access to the actual soil surface or loosen dense surface soils, such as those encountered in heavy traffic areas. If sampling equipment is used to remove surface debris,

the equipment should be decontaminated prior to sampling to reduce the potential for sample interferences.

- When using a hand auger, push and rotate downward until the auger becomes filled with soil. Usually a 6- to 12-inch long core of soil is obtained each time the auger is inserted. Once filled, remove the auger from the ground and empty into a stainless steel bowl. If a VOA sample is required, the sample should be taken directly from the auger using a teaspoon or spatula and/or directly filling the sample container from the auger. Repeat the augering process until the desired sample interval has been augered and placed into the stainless steel bowl.

Backfilling Sample Locations:

Backfill in accordance with federal and state regulations including OAR 690-240 (e.g., bentonite requirements). The soils from the excavation will be used as backfill unless project-specific or state requirements include the use of clean backfill material.

Attachment B

Analytical Laboratory Report (CD-Rom)

APPENDIX D-1
Riverbank Area Surface Soil Summary and Risk Screening, Plants

APPENDIX D-1 Riverbank Area Surface Soil Summary and Risk Screening

Swan Island OU1 Upland Facility - Oregon Screening Levels (Receptors - Plants)

Constituents of Interest (COI)					Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels[1]	Max COI Conc. Exceeds Background ?	Screening Levels for Plant Receptors[2]		COI Conc. (max)	Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Risk Ratio for Multiple COIs	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
CASNo	Analyte	Analyte Group/ Methods	Units	Location Type	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)		Level (mg/kg)	Source	Cij	Tij			Tij/Tj		
83-32-9	Acenaphthene	PAHs	mg/kg	Soil	12	12	0%	0.0141	0.0292			0.0292	NA	NA	20	d	<5%D	NA	No	No	NA	No	No
208-96-8	Acenaphthylene	PAHs	mg/kg	Soil	12	9	25%	0.0141	0.0292	0.0182	0.142	0.142	NA	NA	20	d	0.142	0.007	No	No	0.0002	No	No
120-12-7	Anthracene	PAHs	mg/kg	Soil	12	7	42%	0.0142	0.0292	0.0155	0.0416	0.0416	NA	NA	NA		0.0416	NA	No	No	NA	No	No
7440-36-0	Antimony	Metals	mg/kg	Soil	12	3	75%	0.515	0.537	0.556	2.21	2.21	4	No	5	d	2.21	0.442	No	No	0.010	No	No
12674-11-2	Aroclor 1016	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	NA		<5%D	NA	No	No	NA	No	No
11104-28-2	Aroclor 1221	PCBs	mg/kg	Soil	12	12	0%	0.0696	0.145			0.145	NA	NA	NA		<5%D	NA	No	No	NA	No	No
11141-16-5	Aroclor 1232	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	NA		<5%D	NA	No	No	NA	No	No
53469-21-9	Aroclor 1242	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	NA		<5%D	NA	No	No	NA	No	No
12672-29-6	Aroclor 1248	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	NA		<5%D	NA	No	No	NA	No	No
11097-69-1	Aroclor 1254	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	NA		<5%D	NA	No	No	NA	No	No
11096-82-5	Aroclor 1260	PCBs	mg/kg	Soil	12	0	100%			0.043	0.424	0.424	NA	NA	NA		0.424	NA	No	No	NA	No	No
37324-23-5	Aroclor 1262	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	NA		<5%D	NA	No	No	NA	No	No
11100-14-4	Aroclor 1268	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	NA		<5%D	NA	No	No	NA	No	No
7440-38-2	Arsenic	Metals	mg/kg	Soil	12	0	100%			3.65	9.5	9.5	7	Yes	18	a	9.5	0.528	No	No	0.012	No	No
56-55-3	Benz(a)anthracene	PAHs	mg/kg	Soil	12	0	100%			0.0263	0.101	0.101	NA	NA	NA		0.101	NA	No	No	NA	No	No
50-32-8	Benzo(a)pyrene	PAHs	mg/kg	Soil	12	0	100%			0.0412	0.273	0.273	NA	NA	NA		0.273	NA	No	No	NA	No	No
205-99-2	Benzo(b)fluoranthene	PAHs	mg/kg	Soil	12	0	100%			0.0396	0.22	0.22	NA	NA	NA		0.22	NA	No	No	NA	No	No
191-24-2	Benzo(g,h,i)perylene	PAHs	mg/kg	Soil	12	0	100%			0.052	0.409	0.409	NA	NA	NA		0.409	NA	No	No	NA	No	No
207-08-9	Benzo(k)fluoranthene	PAHs	mg/kg	Soil	12	0	100%			0.0318	0.136	0.136	NA	NA	NA		0.136	NA	No	No	NA	No	No
7440-43-9	Cadmium	Metals	mg/kg	Soil	12	12	0%	0.502	0.55			0.55	1	No	32	a	<5%D	NA	No	No	NA	No	No
1308-38-9	Chromium	Metals	mg/kg	Soil	12	0	100%			13.6	38.5	38.5	42	No	1	d	38.5	38.500	Yes	Yes	0.839	Yes	Yes
218-01-9	Chrysene	PAHs	mg/kg	Soil	12	0	100%			0.0324	0.12	0.12	NA	NA	NA		0.12	NA	No	No	NA	No	No
7440-50-8	Copper	Metals	mg/kg	Soil	12	0	100%			75.3	229	229	36	Yes	70	a	229	3.271	Yes	No	0.071	No	No
53-70-3	Dibenz(a,h)anthracene	PAHs	mg/kg	Soil	12	3	75%	0.0143	0.0292	0.0152	0.0851	0.0851	NA	NA	NA		0.0851	NA	No	No	NA	No	No
	Diesel-Range Organics	NWTPH-Dx	mg/kg	Soil	12	11	8%	12.9	14.1	17.4	17.4	17.4	NA	NA	NA		17.4	NA	No	No	NA	No	No
206-44-0	Fluoranthene	PAHs	mg/kg	Soil	12	0	100%			0.0416	0.181	0.181	NA	NA	NA		0.181	NA	No	No	NA	No	No
86-73-7	Fluorene	PAHs	mg/kg	Soil	12	12	0%	0.0141	0.0292			0.0292	NA	NA	NA		<5%D	NA	No	No	NA	No	No
HORHC	Heavy Oil-Range Hydrocarbons	NWTPH-Dx	mg/kg	Soil	12	7	42%	26.2	28.2	30.8	76.1	76.1	NA	NA	NA		76.1	NA	No	No	NA	No	No
193-39-5	Indeno(1,2,3-cd)pyrene	PAHs	mg/kg	Soil	12	0	100%			0.0394	0.331	0.331	NA	NA	NA		0.331	NA	No	No	NA	No	No
7439-92-1	Lead	Metals	mg/kg	Soil	12	0	100%			19.4	38.6	38.6	17	Yes	120	a	38.6	0.322	No	No	0.007	No	No
7439-97-6	Mercury	Metals	mg/kg	Soil	12	6	50%	0.086	0.0983	0.096	0.135	0.135	0.07	Yes	0.3	d	0.135	0.450	No	No	0.010	No	No
91-20-3	Naphthalene	PAHs	mg/kg	Soil	12	12	0%	0.0141	0.0292			0.0292	NA	NA	10	d	<5%D	NA	No	No	NA	No	No
7440-02-0	Nickel	Metals	mg/kg	Soil	12	0	100%			12.1	42.9	42.9	38	Yes	38	a	42.9	1.129	Yes	No	0.025	No	No
85-01-8	Phenanthrene	PAHs	mg/kg	Soil	12	0	100%			0.0153	0.0941	0.0941	NA	NA	NA		0.0941	NA	No	No	NA	No	No
129-00-0	Pyrene	PAHs	mg/kg	Soil	12	0	100%			0.0498	0.217	0.217	NA	NA	NA		0.217	NA	No	No	NA	No	No
7440-22-4	Silver	Metals	mg/kg	Soil	12	12	0%	0.502	0.55			0.55	1	No	560	a	<5%D	NA	No	No	NA	No	No
1336-36-3	Total PCB	PCBs	mg/kg	Soil	12	0	100%			0.043	0.424	0.424	NA	NA	40	d	0.424	0.011	No	No	0.0002	No	No
TnBT	Tributyltin (TBT)	TBT	mg/kg	Soil	12	0	100%			0.018	3.8	3.8	NA	NA	NA		3.8	NA	No	No	NA	No	No
7440-66-6	Zinc	Metals	mg/kg	Soil	12	0	100%			96.6	194	194	86	Yes	160	a	194	1.213	Yes	No	0.026	No	No

Notes about data included in summary:

Results from surface soil samples collected from BWTP-01 through BWTP-12.

Tj = Sum of toxicity ratios for all COIs in medium j 45.87

Nij = Number of i COIs in medium j 10.00

1/Nij 0.10

Acronyms:

DEQ - Oregon Department of Environmental Quality	COI - constituent of interest
EPA - U.S. Environmental Protection Agency	CPEC - constituent of potential ecological concern
ND - non-detect	SLV - screening level value
mg/kg - milligram per kilogram	Cij -concentration of COI i in medium j
min - minimum	Tij - toxicity ratios for COI i in medium j
max - maximum	T&E - listed threatened and endangered species
NA - not available	Q = 1 for T&E species
<5%D - less than 5% detection frequency	Q = 5 for non-T&E species

Notes about criteria:

1 - Background levels: Oregon Department of Environmental Quality (DEQ). 2002. DEQ Toxicology Workgroup Memorandum to DEQ Cleanup Project Managers regarding "Default background concentrations for metals". October 28, 2002.

2 - Sources of screening levels are as follows:

a - EPA Ecological Soil Screening Levels (EcoSSLs) used for metals, where available.

b - EPA Ecological Soil Screening Levels (EcoSSLs) for low molecular weight PAHs (LMW-PAHs) and high molecular weight PAHs (HMW-PAHs) used for PAHs, where available. LMW-PAHs include 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene. HMW-PAHs include benz(a)anthracene, benzo(a)pyrene benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene,pyrene (note: no values available for plants or birds).

c - WAC Table 749-3 values (Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals) used for diesel-range organics for soil invertebrates, birds, mammals. Diesel-range organics value also used for heavy oil-range hydrocarbons. (note: no values available for plants).

d - Level II Screening Level Values (SLV) from Table 1 in Oregon DEQ (2001) are used for all other analytes (including those lacking levels in the above sources).
(chromium III used for chromium; mercury [elemental, total] used for mercury; acenapthene used for acenaphthylene)

Screening level references:

U.S. Environmental Protection Agency (EPA). 2005. Guidance for Developing Ecological Soil Screening Levels (EcoSSLs). EPA Office of Solid Waste and Emergency Response (OSWER), OSWER Directive 9285.7-55. Published November 2003, Revised November 2005 and subsequent contaminant-specific EcoSSL documents.

Washington Administrative Code (WAC). 2011. Table 792-3 (Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals), Chapter 173-340. Implementing regulations of the Toxics Control Act (MTCA); used by Washington Department of Ecology, Toxics Cleanup Program, Terrestrial Ecological Evaluation Process. Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/table_749-3.htm. Accessed 4/12/2011.

Oregon Department of Environmental Quality (DEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management & Cleanup Division, Final April 1998, updated May 2001.

APPENDIX D-2
Riverbank Area Surface Soil Summary and Risk Screening, Invertebrates

APPENDIX D-2 Riverbank Area Surface Soil Summary and Risk Screening

Swan Island OU1 Upland Facility - Oregon Screening Levels (Receptors - Invertebrates)

Constituents of Interest (COI)					Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels[1]	Max COI Conc. Exceeds Background ?	Screening Levels for Invertebrate Receptors[2]		COI Conc. (max)	Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Risk Ratio for Multiple COIs	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
CASNo	Analyte	Analyte Group/ Methods	Units	Location Type	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)		Level (mg/kg)	Source	Cij	Tij			Tij/Tj		
83-32-9	Acenaphthene	PAHs	mg/kg	Soil	12	12	0%	0.0141	0.0292			0.0292	NA	NA	29	b	<5%D	NA	No	No	NA	No	No
208-96-8	Acenaphthylene	PAHs	mg/kg	Soil	12	9	25%	0.0141	0.0292	0.0182	0.142	0.142	NA	NA	29	b	0.142	0.005	No	No	0.00005	No	No
120-12-7	Anthracene	PAHs	mg/kg	Soil	12	7	42%	0.0142	0.0292	0.0155	0.0416	0.0416	NA	NA	29	b	0.0416	0.001	No	No	0.00001	No	No
7440-36-0	Antimony	Metals	mg/kg	Soil	12	3	75%	0.515	0.537	0.556	2.21	2.21	4	No	78	a	2.21	0.028	No	No	0.0003	No	No
12674-11-2	Aroclor 1016	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	NA		<5%D	NA	No	No	NA	No	No
11104-28-2	Aroclor 1221	PCBs	mg/kg	Soil	12	12	0%	0.0696	0.145			0.145	NA	NA	NA		<5%D	NA	No	No	NA	No	No
11141-16-5	Aroclor 1232	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	NA		<5%D	NA	No	No	NA	No	No
53469-21-9	Aroclor 1242	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	NA		<5%D	NA	No	No	NA	No	No
12672-29-6	Aroclor 1248	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	NA		<5%D	NA	No	No	NA	No	No
11097-69-1	Aroclor 1254	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	NA		<5%D	NA	No	No	NA	No	No
11096-82-5	Aroclor 1260	PCBs	mg/kg	Soil	12	0	100%			0.043	0.424	0.424	NA	NA	NA		0.424	NA	No	No	NA	No	No
37324-23-5	Aroclor 1262	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	NA		<5%D	NA	No	No	NA	No	No
11100-14-4	Aroclor 1268	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	NA		<5%D	NA	No	No	NA	No	No
7440-38-2	Arsenic	Metals	mg/kg	Soil	12	0	100%			3.65	9.5	9.5	7	Yes	60	d	9.5	0.158	No	No	0.002	No	No
56-55-3	Benz(a)anthracene	PAHs	mg/kg	Soil	12	0	100%			0.0263	0.101	0.101	NA	NA	18	b	0.101	0.006	No	No	0.0001	No	No
50-32-8	Benzo(a)pyrene	PAHs	mg/kg	Soil	12	0	100%			0.0412	0.273	0.273	NA	NA	18	b	0.273	0.015	No	No	0.0001	No	No
205-99-2	Benzo(b)fluoranthene	PAHs	mg/kg	Soil	12	0	100%			0.0396	0.22	0.22	NA	NA	18	b	0.22	0.012	No	No	0.0001	No	No
191-24-2	Benzo(g,h,i)perylene	PAHs	mg/kg	Soil	12	0	100%			0.052	0.409	0.409	NA	NA	18	b	0.409	0.023	No	No	0.0002	No	No
207-08-9	Benzo(k)fluoranthene	PAHs	mg/kg	Soil	12	0	100%			0.0318	0.136	0.136	NA	NA	18	b	0.136	0.008	No	No	0.0001	No	No
7440-43-9	Cadmium	Metals	mg/kg	Soil	12	12	0%	0.502	0.55			0.55	1	No	140	a	<5%D	NA	No	No	NA	No	No
1308-38-9	Chromium	Metals	mg/kg	Soil	12	0	100%			13.6	38.5	38.5	42	No	0.4	d	38.5	96.250	Yes	Yes	0.934	Yes	Yes
218-01-9	Chrysene	PAHs	mg/kg	Soil	12	0	100%			0.0324	0.12	0.12	NA	NA	18	b	0.12	0.007	No	No	0.0001	No	No
7440-50-8	Copper	Metals	mg/kg	Soil	12	0	100%			75.3	229	229	36	Yes	80	a	229	2.863	Yes	No	0.028	No	No
53-70-3	Dibenz(a,h)anthracene	PAHs	mg/kg	Soil	12	3	75%	0.0143	0.0292	0.0152	0.0851	0.0851	NA	NA	18	b	0.0851	0.005	No	No	0.00005	No	No
	Diesel-Range Organics	NWTPH-Dx	mg/kg	Soil	12	11	8%	12.9	14.1	17.4	17.4	17.4	NA	NA	200	c	17.4	0.087	No	No	0.001	No	No
206-44-0	Fluoranthene	PAHs	mg/kg	Soil	12	0	100%			0.0416	0.181	0.181	NA	NA	18	b	0.181	0.010	No	No	0.0001	No	No
86-73-7	Fluorene	PAHs	mg/kg	Soil	12	12	0%	0.0141	0.0292			0.0292	NA	NA	29	b	<5%D	NA	No	No	NA	No	No
HORHC	Heavy Oil-Range Hydrocarbons	NWTPH-Dx	mg/kg	Soil	12	7	42%	26.2	28.2	30.8	76.1	76.1	NA	NA	200	c	76.1	0.381	No	No	0.004	No	No
193-39-5	Indeno(1,2,3-cd)pyrene	PAHs	mg/kg	Soil	12	0	100%			0.0394	0.331	0.331	NA	NA	18	b	0.331	0.018	No	No	0.0002	No	No
7439-92-1	Lead	Metals	mg/kg	Soil	12	0	100%			19.4	38.6	38.6	17	Yes	1700	a	38.6	0.023	No	No	0.0002	No	No
7439-97-6	Mercury	Metals	mg/kg	Soil	12	6	50%	0.086	0.0983	0.096	0.135	0.135	0.07	Yes	0.1	d	0.135	1.350	Yes	No	0.013	No	No
91-20-3	Naphthalene	PAHs	mg/kg	Soil	12	12	0%	0.0141	0.0292			0.0292	NA	NA	29	b	<5%D	NA	No	No	NA	No	No
7440-02-0	Nickel	Metals	mg/kg	Soil	12	0	100%			12.1	42.9	42.9	38	Yes	280	a	42.9	0.153	No	No	0.001	No	No
85-01-8	Phenanthrene	PAHs	mg/kg	Soil	12	0	100%			0.0153	0.0941	0.0941	NA	NA	29	b	0.0941	0.003	No	No	0.00003	No	No
129-00-0	Pyrene	PAHs	mg/kg	Soil	12	0	100%			0.0498	0.217	0.217	NA	NA	18	b	0.217	0.012	No	No	0.0001	No	No
7440-22-4	Silver	Metals	mg/kg	Soil	12	12	0%	0.502	0.55			0.55	1	No	50	d	<5%D	NA	No	No	NA	No	No
1336-36-3	Total PCB	PCBs	mg/kg	Soil	12	0	100%			0.043	0.424	0.424	NA	NA	NA		0.424	NA	No	No	NA	No	No
TnBT	Tributyltin (TBT)	TBT	mg/kg	Soil	12	0	100%			0.018	3.8	3.8	NA	NA	NA		3.8	NA	No	No	NA	No	No
7440-66-6	Zinc	Metals	mg/kg	Soil	12	0	100%			96.6	194	194	86	Yes	120	a	194	1.617	Yes	No	0.016	No	No

Notes about data included in summary:
Results from surface soil samples collected from BWTP-01 through BWTP-12.

Tj = Sum of toxicity ratios for all COIs in medium j 103.03
Nij = Number of i COIs in medium j 23.00
1/Nij= 0.04

Acronyms:

DEQ - Oregon Department of Environmental Quality	COI - constituent of interest
EPA - U.S. Environmental Protection Agency	CPEC - constituent of potential ecological concern
ND - non-detect	SLV - screening level value
mg/kg - milligram per kilogram	Cij -concentration of COI i in medium j
min - minimum	Tij - toxicity ratios for COI i in medium j
max - maximum	T&E - listed threatened and endangered species
NA - not available	Q = 1 for T&E species
<5%D - less than 5% detection frequency	Q = 5 for non-T&E species

Notes about criteria:

1 - Background levels: Oregon Department of Environmental Quality (DEQ). 2002. DEQ Toxicology Workgroup Memorandum to DEQ Cleanup Project Managers regarding "Default background concentrations for metals". October 28, 2002.

2 - Sources of screening levels are as follows:

a - EPA Ecological Soil Screening Levels (EcoSSLs) used for metals, where available.

b - EPA Ecological Soil Screening Levels (EcoSSLs) for low molecular weight PAHs (LMW-PAHs) and high molecular weight PAHs (HMW-PAHs) used for PAHs, where available. LMW-PAHs include 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene. HMW-PAHs include benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene,pyrene (note: no values available for plants or birds).

c - WAC Table 749-3 values (Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals) used for diesel-range organics for soil invertebrates, birds, mammals. Diesel-range organics value also used for heavy oil-range hydrocarbons. (note: no values available for plants).

d - Level II Screening Level Values (SLV) from Table 1 in Oregon DEQ (2001) are used for all other analytes (including those lacking levels in the above sources).
(arsenic III used for arsenic; chromium III used for chromium; mercury [elemental, total] used for mercury)

Screening level references:

U.S. Environmental Protection Agency (EPA). 2005. Guidance for Developing Ecological Soil Screening Levels (EcoSSLs). EPA Office of Solid Waste and Emergency Response (OSWER), OSWER Directive 9285.7-55. Published November 2003, Revised November 2005 and subsequent contaminant-specific EcoSSL documents.

Washington Administrative Code (WAC). 2011. Table 792-3 (Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals), Chapter 173-340. Implementing regulations of the Toxics Control Act (MTCA); used by Washington Department of Ecology, Toxics Cleanup Program, Terrestrial Ecological Evaluation Process. Available at http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/table_749-3.htm. Accessed 4/12/2011.

Oregon Department of Environmental Quality (DEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management & Cleanup Division, Final April 1998, updated May 2001.

APPENDIX D-3
Riverbank Area Surface Soil Summary and Risk Screening, Birds

APPENDIX D-3 Riverbank Area Surface Soil Summary and Risk Screening

Swan Island OU1 Upland Facility - Oregon Screening Levels (Receptors - Birds)

Constituents of Interest (COI)					Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels[1]	Max COI Conc. Exceeds Background ?	Screening Levels for Bird Receptors[2]		COI Conc. (max)	Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Risk Ratio for Multiple COIs	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
CASNo	Analyte	Analyte Group/ Methods	Units	Location Type	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)		Level (mg/kg)	Source	Cij	Tij			Tij/Tj		
83-32-9	Acenaphthene	PAHs	mg/kg	Soil	12	12	0%	0.0141	0.0292			0.0292	NA	NA	NA		<5%D	NA	No	No	NA	No	No
208-96-8	Acenaphthylene	PAHs	mg/kg	Soil	12	9	25%	0.0141	0.0292	0.0182	0.142	0.142	NA	NA	NA		0.142	NA	No	No	NA	No	No
120-12-7	Anthracene	PAHs	mg/kg	Soil	12	7	42%	0.0142	0.0292	0.0155	0.0416	0.0416	NA	NA	NA		0.0416	NA	No	No	NA	No	No
7440-36-0	Antimony	Metals	mg/kg	Soil	12	3	75%	0.515	0.537	0.556	2.21	2.21	4	No	NA		2.21	NA	No	No	NA	No	No
12674-11-2	Aroclor 1016	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	0.7	e	<5%D	NA	No	No	NA	No	No
11104-28-2	Aroclor 1221	PCBs	mg/kg	Soil	12	12	0%	0.0696	0.145			0.145	NA	NA	0.7	e	<5%D	NA	No	No	NA	No	No
11141-16-5	Aroclor 1232	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	0.7	e	<5%D	NA	No	No	NA	No	No
53469-21-9	Aroclor 1242	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	1.5	e	<5%D	NA	No	No	NA	No	No
12672-29-6	Aroclor 1248	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	0.7	e	<5%D	NA	No	No	NA	No	No
11097-69-1	Aroclor 1254	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	0.7	e	<5%D	NA	No	No	NA	No	No
11096-82-5	Aroclor 1260	PCBs	mg/kg	Soil	12	0	100%			0.043	0.424	0.424	NA	NA	0.7	e	0.424	0.6	No	No	0.031	No	No
37324-23-5	Aroclor 1262	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	0.7	e	<5%D	NA	No	No	NA	No	No
11100-14-4	Aroclor 1268	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	0.7	e	<5%D	NA	No	No	NA	No	No
7440-38-2	Arsenic	Metals	mg/kg	Soil	12	0	100%			3.65	9.5	9.5	7	Yes	43	a	9.5	0.2	No	No	0.011	No	No
56-55-3	Benz(a)anthracene	PAHs	mg/kg	Soil	12	0	100%			0.0263	0.101	0.101	NA	NA	NA		0.101	NA	No	No	NA	No	No
50-32-8	Benzo(a)pyrene	PAHs	mg/kg	Soil	12	0	100%			0.0412	0.273	0.273	NA	NA	12	d	0.273	0.02	No	No	0.001	No	No
205-99-2	Benzo(b)fluoranthene	PAHs	mg/kg	Soil	12	0	100%			0.0396	0.22	0.22	NA	NA	NA		0.22	NA	No	No	NA	No	No
191-24-2	Benzo(g,h,i)perylene	PAHs	mg/kg	Soil	12	0	100%			0.052	0.409	0.409	NA	NA	NA		0.409	NA	No	No	NA	No	No
207-08-9	Benzo(k)fluoranthene	PAHs	mg/kg	Soil	12	0	100%			0.0318	0.136	0.136	NA	NA	NA		0.136	NA	No	No	NA	No	No
7440-43-9	Cadmium	Metals	mg/kg	Soil	12	12	0%	0.502	0.55			0.55	1	No	0.77	a	<5%D	NA	No	No	NA	No	No
1308-38-9	Chromium	Metals	mg/kg	Soil	12	0	100%			13.6	38.5	38.5	42	No	26	a	38.5	1.5	Yes	No	0.077	No	No
218-01-9	Chrysene	PAHs	mg/kg	Soil	12	0	100%			0.0324	0.12	0.12	NA	NA	NA		0.12	NA	No	No	NA	No	No
7440-50-8	Copper	Metals	mg/kg	Soil	12	0	100%			75.3	229	229	36	Yes	28	a	229	8.2	Yes	Yes	0.423	Yes	Yes
53-70-3	Dibenz(a,h)anthracene	PAHs	mg/kg	Soil	12	3	75%	0.0143	0.0292	0.0152	0.0851	0.0851	NA	NA	NA		0.0851	NA	No	No	NA	No	No
	Diesel-Range Organics	NWTPH-Dx	mg/kg	Soil	12	11	8%	12.9	14.1	17.4	17.4	17.4	NA	NA	6000	c	17.4	0.003	No	No	0.0002	No	No
206-44-0	Fluoranthene	PAHs	mg/kg	Soil	12	0	100%			0.0416	0.181	0.181	NA	NA	NA		0.181	NA	No	No	NA	No	No
86-73-7	Fluorene	PAHs	mg/kg	Soil	12	12	0%	0.0141	0.0292			0.0292	NA	NA	NA		<5%D	NA	No	No	NA	No	No
HORHC	Heavy Oil-Range Hydrocarbons	NWTPH-Dx	mg/kg	Soil	12	7	42%	26.2	28.2	30.8	76.1	76.1	NA	NA	6000	c	76.1	0.0	No	No	0.001	No	No
193-39-5	Indeno(1,2,3-cd)pyrene	PAHs	mg/kg	Soil	12	0	100%			0.0394	0.331	0.331	NA	NA	NA		0.331	NA	No	No	NA	No	No
7439-92-1	Lead	Metals	mg/kg	Soil	12	0	100%			19.4	38.6	38.6	17	Yes	11	a	38.6	3.5	Yes	No	0.182	Yes	No
7439-97-6	Mercury	Metals	mg/kg	Soil	12	6	50%	0.086	0.0983	0.096	0.135	0.135	0.07	Yes	1.5	e	0.135	0.1	No	No	0.005	No	No
91-20-3	Naphthalene	PAHs	mg/kg	Soil	12	12	0%	0.0141	0.0292			0.0292	NA	NA	NA		<5%D	NA	No	No	NA	No	No
7440-02-0	Nickel	Metals	mg/kg	Soil	12	0	100%			12.1	42.9	42.9	38	Yes	210	a	42.9	0.2	No	No	0.011	No	No
85-01-8	Phenanthrene	PAHs	mg/kg	Soil	12	0	100%			0.0153	0.0941	0.0941	NA	NA	NA		0.0941	NA	No	No	NA	No	No
129-00-0	Pyrene	PAHs	mg/kg	Soil	12	0	100%			0.0498	0.217	0.217	NA	NA	NA		0.217	NA	No	No	NA	No	No
7440-22-4	Silver	Metals	mg/kg	Soil	12	12	0%	0.502	0.55			0.55	1	No	4.2	a	<5%D	NA	No	No	NA	No	No
1336-36-3	Total PCB	PCBs	mg/kg	Soil	12	0	100%			0.043	0.424	0.424	NA	NA	0.65	d	0.424	0.7	No	No	0.034	No	No
TnBT	Tributyltin (TBT)	TBT	mg/kg	Soil	12	0	100%			0.018	3.8	3.8	NA	NA	28	e	3.8	0.1	No	No	0.007	No	No
7440-66-6	Zinc	Metals	mg/kg	Soil	12	0	100%			96.6	194	194	86	Yes	46	a	194	4.2	Yes	No	0.218	Yes	No

Notes about data included in summary:
Results from surface soil samples collected from BWTP-01 through BWTP-12.

Tj = Sum of toxicity ratios for all COIs in medium j 19.33
Nij = Number of i COIs in medium j 13.00
1/Nij= 0.08

Acronyms:

DEQ - Oregon Department of Environmental Quality
EPA - U.S. Environmental Protection Agency
ND - non-detect
mg/kg - milligram per kilogram
min - minimum
max - maximum
NA - not available
<5%D - less than 5% detection frequency
COI - constituent of interest
CPEC - constituent of potential ecological concern
SLV - screening level value
Cij -concentration of COI i in medium j
Tij - toxicity ratios for COI i in medium j
T&E - listed threatened and endangered species
Q = 1 for T&E species
Q = 5 for non-T&E species

Notes about criteria:

1 - Background levels: Oregon Department of Environmental Quality (DEQ). 2002. DEQ Toxicology Workgroup Memorandum to DEQ Cleanup Project Managers regarding "Default background concentrations for metals". October 28, 2002.

2 - Sources of screening levels are as follows:

a - EPA Ecological Soil Screening Levels (EcoSSLs) used for metals, where available. (chromium III criteria used for chromium)

b - EPA Ecological Soil Screening Levels (EcoSSLs) for low molecular weight PAHs (LMW-PAHs) and high molecular weight PAHs (HMW-PAHs) used for PAHs, where available. LMW-PAHs include 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene. HMW-PAHs include benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene,pyrene (note: no values available for plants or birds).

c - WAC Table 749-3 values (Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals) used for diesel-range organics for soil invertebrates, birds, mammals. Diesel-range organics value also used for heavy oil-range hydrocarbons. (note: no values available for plants).

d - WAC Table 749-3 values (Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals) used for PCB mixtures (totals) for birds and mammals. Benzo(a)pyrene value used for birds.

e - Level II Screening Level Values (SLV) from Table 1 in Oregon DEQ (2001) are used for all other analytes (including those lacking levels in the above sources).
(mercury [elemental, total] used for mercury; Aroclor 1254 used for Aroclors without criteria; tributyltin oxide used for tri-n-butyltin)

Screening level references:

U.S. Environmental Protection Agency (EPA). 2005. Guidance for Developing Ecological Soil Screening Levels (EcoSSLs). EPA Office of Solid Waste and Emergency Response (OSWER), OSWER Directive 9285.7-55. Published November 2003, Revised November 2005 and subsequent contaminant-specific EcoSSL documents.

Washington Administrative Code (WAC). 2011. Table 792-3 (Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals), Chapter 173-340. Implementing regulations of the Toxics Control Act (MTCA); used by Washington Department of Ecology, Toxics Cleanup Program, Terrestrial Ecological Evaluation Process. Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/table_749-3.htm. Accessed 4/12/2011.

Oregon Department of Environmental Quality (DEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management & Cleanup Division, Final April 1998, updated May 2001.

APPENDIX D-4
Riverbank Area Surface Soil Summary and Risk Screening, Mammals

APPENDIX D-4 Riverbank Area Surface Soil Summary and Risk Screening

Swan Island OU1 Upland Facility - Oregon Screening Levels (Receptors - Mammals)

Constituents of Interest (COI)					Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels[1]	Max COI Conc. Exceeds Background ?	Screening Levels for Mammal Receptors[2]		COI Conc. (max)	Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Risk Ratio for Multiple COIs	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
CASNo	Analyte	Analyte Group/ Methods	Units	Location Type	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)		Level (mg/kg)	Source	Cij	Tij			Tij/Tj		
83-32-9	Acenaphthene	PAHs	mg/kg	Soil	12	12	0%	0.0141	0.0292			0.0292	NA	NA	100	b	<5%D	NA	No	No	NA	No	No
208-96-8	Acenaphthylene	PAHs	mg/kg	Soil	12	9	25%	0.0141	0.0292	0.0182	0.142	0.142	NA	NA	100	b	0.142	0.001	No	No	0.0001	No	No
120-12-7	Anthracene	PAHs	mg/kg	Soil	12	7	42%	0.0142	0.0292	0.0155	0.0416	0.0416	NA	NA	100	b	0.0416	0.0004	No	No	0.00002	No	No
7440-36-0	Antimony	Metals	mg/kg	Soil	12	3	75%	0.515	0.537	0.556	2.21	2.21	4	No	0.27	a	2.21	8.2	Yes	Yes	0.420	Yes	Yes
12674-11-2	Aroclor 1016	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	100	e	<5%D	NA	No	No	NA	No	No
11104-28-2	Aroclor 1221	PCBs	mg/kg	Soil	12	12	0%	0.0696	0.145			0.145	NA	NA	4	e	<5%D	NA	No	No	NA	No	No
11141-16-5	Aroclor 1232	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	4	e	<5%D	NA	No	No	NA	No	No
53469-21-9	Aroclor 1242	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	5	e	<5%D	NA	No	No	NA	No	No
12672-29-6	Aroclor 1248	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	4	e	<5%D	NA	No	No	NA	No	No
11097-69-1	Aroclor 1254	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	4	e	<5%D	NA	No	No	NA	No	No
11096-82-5	Aroclor 1260	PCBs	mg/kg	Soil	12	0	100%			0.043	0.424	0.424	NA	NA	4	e	0.424	0.1	No	No	0.005	No	No
37324-23-5	Aroclor 1262	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	4	e	<5%D	NA	No	No	NA	No	No
11100-14-4	Aroclor 1268	PCBs	mg/kg	Soil	12	12	0%	0.0346	0.0719			0.0719	NA	NA	4	e	<5%D	NA	No	No	NA	No	No
7440-38-2	Arsenic	Metals	mg/kg	Soil	12	0	100%			3.65	9.5	9.5	7	Yes	46	a	9.5	0.2	No	No	0.011	No	No
56-55-3	Benz(a)anthracene	PAHs	mg/kg	Soil	12	0	100%			0.0263	0.101	0.101	NA	NA	1.1	b	0.101	0.1	No	No	0.005	No	No
50-32-8	Benzo(a)pyrene	PAHs	mg/kg	Soil	12	0	100%			0.0412	0.273	0.273	NA	NA	1.1	b	0.273	0.2	No	No	0.013	No	No
205-99-2	Benzo(b)fluoranthene	PAHs	mg/kg	Soil	12	0	100%			0.0396	0.22	0.22	NA	NA	1.1	b	0.22	0.2	No	No	0.010	No	No
191-24-2	Benzo(g,h,i)perylene	PAHs	mg/kg	Soil	12	0	100%			0.052	0.409	0.409	NA	NA	1.1	b	0.409	0.4	No	No	0.019	No	No
207-08-9	Benzo(k)fluoranthene	PAHs	mg/kg	Soil	12	0	100%			0.0318	0.136	0.136	NA	NA	1.1	b	0.136	0.1	No	No	0.006	No	No
7440-43-9	Cadmium	Metals	mg/kg	Soil	12	12	0%	0.502	0.55			0.55	1	No	0.36	a	<5%D	NA	ND>SLV	ND>SLV	NA	No	No
1308-38-9	Chromium	Metals	mg/kg	Soil	12	0	100%			13.6	38.5	38.5	42	No	130	a	38.5	0.3	No	No	0.015	No	No
218-01-9	Chrysene	PAHs	mg/kg	Soil	12	0	100%			0.0324	0.12	0.12	NA	NA	1.1	b	0.12	0.1	No	No	0.006	No	No
7440-50-8	Copper	Metals	mg/kg	Soil	12	0	100%			75.3	229	229	36	Yes	49	a	229	4.7	Yes	No	0.240	Yes	Yes
53-70-3	Dibenz(a,h)anthracene	PAHs	mg/kg	Soil	12	3	75%	0.0143	0.0292	0.0152	0.0851	0.0851	NA	NA	1.1	b	0.0851	0.1	No	No	0.004	No	No
	Diesel-Range Organics	NWTPH-Dx	mg/kg	Soil	12	11	8%	12.9	14.1	17.4	17.4	17.4	NA	NA	6000	c	17.4	0.003	No	No	0.0001	No	No
206-44-0	Fluoranthene	PAHs	mg/kg	Soil	12	0	100%			0.0416	0.181	0.181	NA	NA	1.1	b	0.181	0.2	No	No	0.008	No	No
86-73-7	Fluorene	PAHs	mg/kg	Soil	12	12	0%	0.0141	0.0292			0.0292	NA	NA	100	b	<5%D	NA	No	No	NA	No	No
HORHC	Heavy Oil-Range Hydrocarbons	NWTPH-Dx	mg/kg	Soil	12	7	42%	26.2	28.2	30.8	76.1	76.1	NA	NA	6000	c	76.1	0.01	No	No	0.001	No	No
193-39-5	Indeno(1,2,3-cd)pyrene	PAHs	mg/kg	Soil	12	0	100%			0.0394	0.331	0.331	NA	NA	1.1	b	0.331	0.3	No	No	0.015	No	No
7439-92-1	Lead	Metals	mg/kg	Soil	12	0	100%			19.4	38.6	38.6	17	Yes	56	a	38.6	0.7	No	No	0.035	No	No
7439-97-6	Mercury	Metals	mg/kg	Soil	12	6	50%	0.086	0.0983	0.096	0.135	0.135	0.07	Yes	73	e	0.135	0.002	No	No	0.0001	No	No
91-20-3	Naphthalene	PAHs	mg/kg	Soil	12	12	0%	0.0141	0.0292			0.0292	NA	NA	100	b	<5%D	NA	No	No	NA	No	No
7440-02-0	Nickel	Metals	mg/kg	Soil	12	0	100%			12.1	42.9	42.9	38	Yes	130	a	42.9	0.3	No	No	0.017	No	No
85-01-8	Phenanthrene	PAHs	mg/kg	Soil	12	0	100%			0.0153	0.0941	0.0941	NA	NA	100	b	0.0941	0.001	No	No	0.00005	No	No
129-00-0	Pyrene	PAHs	mg/kg	Soil	12	0	100%			0.0498	0.217	0.217	NA	NA	1.1	b	0.217	0.2	No	No	0.010	No	No
7440-22-4	Silver	Metals	mg/kg	Soil	12	12	0%	0.502	0.55			0.55	1	No	14	a	<5%D	NA	No	No	NA	No	No
1336-36-3	Total PCB	PCBs	mg/kg	Soil	12	0	100%			0.043	0.424	0.424	NA	NA	0.65	d	0.424	0.7	No	No	0.033	No	No
TnBT	Tributyltin (TBT)	TBT	mg/kg	Soil	12	0	100%			0.018	3.8	3.8	NA	NA	1300	e	3.8	0.003	No	No	0.0001	No	No
7440-66-6	Zinc	Metals	mg/kg	Soil	12	0	100%			96.6	194	194	86	Yes	79	a	194	2.5	Yes	No	0.126	Yes	No

Notes about data included in summary:
Results from surface soil samples collected from BWTP-01 through BWTP-12.

Tj = Sum of toxicity ratios for all COIs in medium j 19.50
Nij = Number of i COIs in medium j 26.00
1/Nij= 0.04

Acronyms:

DEQ - Oregon Department of Environmental Quality	COI - constituent of interest
EPA - U.S. Environmental Protection Agency	CPEC - constituent of potential ecological concern
ND - non-detect	SLV - screening level value
mg/kg - milligram per kilogram	Cij -concentration of COI i in medium j
min - minimum	Tij - toxicity ratios for COI i in medium j
max - maximum	T&E - listed threatened and endangered species
NA - not available	Q = 1 for T&E species
<5%D - less than 5% detection frequency	Q = 5 for non-T&E species

Notes about criteria:

1 - Background levels: Oregon Department of Environmental Quality (DEQ). 2002. DEQ Toxicology Workgroup Memorandum to DEQ Cleanup Project Managers regarding "Default background concentrations for metals". October 28, 2002.

2 - Sources of screening levels are as follows:

a - EPA Ecological Soil Screening Levels (EcoSSLs) used for metals, where available. (chromium VI criteria used for chromium)

b - EPA Ecological Soil Screening Levels (EcoSSLs) for low molecular weight PAHs (LMW-PAHs) and high molecular weight PAHs (HMW-PAHs) used for PAHs, where available. LMW-PAHs include 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene. HMW-PAHs include benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene,pyrene (note: no values available for plants or birds).

c - WAC Table 749-3 values (Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals) used for diesel-range organics for soil invertebrates, birds, mammals. Diesel-range organics value also used for heavy oil-range hydrocarbons. (note: no values available for plants).

d - WAC Table 749-3 values (Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals) used for PCB mixtures (totals) for birds and mammals. Benzo(a)pyrene value used for birds.

e - Level II Screening Level Values (SLV) from Table 1 in Oregon DEQ (2001) are used for all other analytes (including those lacking levels in the above sources).
(mercury [elemental, total] used for mercury; Aroclor 1254 used for Aroclors without criteria; tributyltin oxide used for tri-n-butyltin)

Screening level references:

U.S. Environmental Protection Agency (EPA). 2005. Guidance for Developing Ecological Soil Screening Levels (EcoSSLs). EPA Office of Solid Waste and Emergency Response (OSWER), OSWER Directive 9285.7-55. Published November 2003, Revised November 2005 and subsequent contaminant-specific EcoSSL documents.

Washington Administrative Code (WAC). 2011. Table 792-3 (Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals), Chapter 173-340. Implementing regulations of the Toxics Control Act (MTCA); used by Washington Department of Ecology, Toxics Cleanup Program, Terrestrial Ecological Evaluation Process. Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/table_749-3.htm. Accessed 4/12/2011.

Oregon Department of Environmental Quality (DEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management & Cleanup Division, Final April 1998, updated May 2001.

APPENDIX D-5
Riverbank Area Surface Soil Summary and Risk Screening (90UCL), Wildlife Receptors

APPENDIX D-5 Riverbank Area Surface Soil Summary and Risk Screening

Swan Island OU1 Upland Facility - Oregon Screening Levels (Receptors - Birds)

Constituents of Interest (COI)			Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels*	Screening Levels*	COI Concentration (90 UCL)				Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV- Individual COI Risk? (Q=5)
			Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)	Bird Receptors	n	Cij	Dist.	Estimation Method	Tij		
CASNo	Analyte	Units																	
7440-50-8	Copper	mg/kg	12	0	100%			75.3	229	229	36	28	12	143.5	Normal	90% Student's-t UCL	5.1	Yes	Yes
7439-92-1	Lead	mg/kg	12	0	100%			19.4	38.6	38.6	17	11	12	31.6	Normal	90% Student's-t UCL	2.9	Yes	No
7440-66-6	Zinc	mg/kg	12	0	100%			96.6	194	194	86	46	12	151.3	Normal	90% Student's-t UCL	3.3	Yes	No

Swan Island OU1 Upland Facility - Oregon Screening Levels (Receptors - Mammals)

Constituents of Interest (COI)			Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels*	Screening Levels*	COI Concentration (90 UCL)				Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV- Individual COI Risk? (Q=5)
			Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)	Mammal Receptors	n	Cij	Dist.	Estimation Method	Tij		
CASNo	Analyte	Units																	
7440-36-0	Antimony	mg/kg	12	3	75%	0.515	0.537	0.556	2.21	2.21	4	0.27	12	1.06	Gamma	90% KM (Percentile Bootstrap) UCL	3.9	Yes	No
7440-38-2	Arsenic	mg/kg	12	0	100%			3.65	9.5	9.5	7	46	12	5.64	Unknown	90% Student's-t UCL	0.1	No	No
7440-50-8	Copper	mg/kg	12	0	100%			75.3	229	229	36	49	12	143.5	Normal	90% Student's-t UCL	2.9	Yes	No
1336-36-3	Zinc	mg/kg	12	0	100%			96.6	194	194	86	79	12	151.3	Normal	90% Student's-t UCL	1.9	Yes	No

Notes:
90UCL - 90% upper confidence limit
mg/kg - milligram per kilogram
min - minimum
max - maximum
COI - constituent of interest
CPEC - constituent of potential ecological concern
SLV - screening level value
Cij -concentration of COI i in medium j
Tij - toxicity ratios for COI i in medium j
n - sample size
T&E - listed threatened and endangered species
Q = 1 for listed threatened and endangered (T&E) species
Q = 5 for non-T&E species
DEQ - Oregon Department of Environmental Quality

90UCLs were calculated using USEPA ProUCL software, version 4.00.04 (refer to Appendix D-6).
Refer to Appendices D-3 and D-4 for descriptions of screening levels and background levels.

APPENDIX D-6
Riverbank Area Surface Soil Data – ProUCL Output

APPENDIX D-6 Riverbank Area Surface Soil Data – ProUCL Output

Swan Island OU1 Upland Facility

Notes: 90UCLs were calculated using USEPA ProUCL software, version 4.00.04. Selected values (presented in Appendix D-5) are highlighted. ProUCL only provides recommended values for 95UCLs; so, 95UCL calculations were run and used for guidance. 95UCL output is presented below 90UCL output, for reference.

90UCL Output

General UCL Statistics for Data Sets with Non-Detects

User Selected Options	
From File	S:\Jobs\0219-018-900-SIUF-OU1-Upland\Data\ProUCL\SIUF_OU1_ProUCL_INPUT_revND.wst
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Result (antimony) 90UCL Output

General Statistics

Number of Valid Data	12	Number of Detected Data	9
Number of Distinct Detected Data	9	Number of Non-Detect Data	3
		Percent Non-Detects	25.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.556	Minimum Detected	-0.587
Maximum Detected	2.21	Maximum Detected	0.793
Mean of Detected	0.945	Mean of Detected	-0.167
SD of Detected	0.546	SD of Detected	0.464
Minimum Non-Detect	0.515	Minimum Non-Detect	-0.664
Maximum Non-Detect	0.537	Maximum Non-Detect	-0.622

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	3
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	9
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	25.00%

Warning: There are only 9 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.734	Shapiro Wilk Test Statistic	0.844
5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		*DL/2 Substitution Method*	
Mean	0.774	Mean	-0.459
SD	0.558	SD	0.659
90% DL/2 (t) UCL	0.994	90% H-Stat (DL/2) UCL	1.003

Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.742	Mean in Log Scale	-0.44
SD	0.59	SD in Log Scale	0.632
90% MLE (t) UCL	0.974	Mean in Original Scale	0.78
90% MLE (Tiku) UCL	0.978	SD in Original Scale	0.553
		90% Percentile Bootstrap UCL	0.974
		90% BCA Bootstrap UCL	1.039

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	3.196	Data Follow Appr. Gamma Distribution at 5% Significance Level
Theta Star	0.296	
nu star	57.53	

A-D Test Statistic	0.784	Nonparametric Statistics	
5% A-D Critical Value	0.723	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.723	Mean	0.848
5% K-S Critical Value	0.28	SD	0.477
Data follow Appr. Gamma Distribution at 5% Significance Level		*SE of Mean*	0.146
		90% KM (t) UCL	1.046
		90% KM (z) UCL	1.035
		90% KM (jackknife) UCL	1.042
Assuming Gamma Distribution		90% KM (bootstrap t) UCL	1.394
Gamma ROS Statistics using Extrapolated Data		90% KM (BCA) UCL	1.035
Minimum	0.44	90% KM (Percentile Bootstrap) UCL	1.056
Maximum	2.21	90% KM (Chebyshev) UCL	1.285
Mean	0.819	95% KM (Chebyshev) UCL	1.484
Median	0.637	97.5% KM (Chebyshev) UCL	1.759
SD	0.519	99% KM (Chebyshev) UCL	2.299
k star	3.05		
Theta star	0.268		
Nu star	73.19		

APPENDIX D-6 Riverbank Area Surface Soil Data – ProUCL Output

AppChi2		58.17	Potential UCL to Use
90% Gamma Approximate UCL		1.03	Recommendation Provided only
90% Adjusted Gamma UCL		1.059	for 95% Confidence Coeficient

Note: DL/2 is not a recommended method.

Result (arsenic) **90UCL Output**

General Statistics			
Number of Valid Observations	12	Number of Distinct Observations	12
Raw Statistics		Log-transformed Statistics	
Minimum	3.65	Minimum of Log Data	1.295
Maximum	9.5	Maximum of Log Data	2.251
Mean	4.978	Mean of log Data	1.565
Median	4.335	SD of log Data	0.275
SD	1.689		
Coefficient of Variation	0.339		
Skewness	2.22		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.68	Shapiro Wilk Test Statistic	0.764
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	5.642	90% H-UCL	5.588
		90% Chebyshev (MVUE) UCL	6.14
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	6.679
90% Adjusted-CLT UCL	5.826	97.5% Chebyshev (MVUE) UCL	7.427
90% Modified-t UCL	5.694	99% Chebyshev (MVUE) UCL	8.895
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	9.586	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.519		
MLE of Mean	4.978		
MLE of Standard Deviation	1.608		
nu star	230.1		
Approximate Chi Square Value (.05)	203	Nonparametric Statistics	
Adjusted Level of Significance	0.0752	90% CLT UCL	5.602
Adjusted Chi Square Value	200	90% Jackknife UCL	5.642
		90% Standard Bootstrap UCL	5.582
Anderson-Darling Test Statistic	1.422	90% Bootstrap-t UCL	7.294
Anderson-Darling 5% Critical Value	0.731	90% Hall's Bootstrap UCL	9.992
Kolmogorov-Smirnov Test Statistic	0.301	90% Percentile Bootstrap UCL	5.628
Kolmogorov-Smirnov 5% Critical Value	0.245	90% BCA Bootstrap UCL	5.84
Data not Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	6.44
		95% Chebyshev(Mean, Sd) UCL	7.103
		97.5% Chebyshev(Mean, Sd) UCL	8.023
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	9.829
90% Approximate Gamma UCL	5.64		
90% Adjusted Gamma UCL	5.727		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	

Result (copper) **90UCL Output**

General Statistics			
Number of Valid Observations	12	Number of Distinct Observations	12
Raw Statistics		Log-transformed Statistics	
Minimum	75.3	Minimum of Log Data	4.321
Maximum	229	Maximum of Log Data	5.434
Mean	125.9	Mean of log Data	4.783
Median	120	SD of log Data	0.33
SD	44.87		
Coefficient of Variation	0.357		
Skewness	1.26		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.887	Shapiro Wilk Test Statistic	0.957
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	143.5	90% H-UCL	145.7
		90% Chebyshev (MVUE) UCL	161.8
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	178.2
90% Adjusted-CLT UCL	145.8	97.5% Chebyshev (MVUE) UCL	201
90% Modified-t UCL	144.3	99% Chebyshev (MVUE) UCL	245.8
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	7.382	Data appear Normal at 5% Significance Level	
Theta Star	17.05		

APPENDIX D-6 Riverbank Area Surface Soil Data – ProUCL Output

MLE of Mean	125.9		
MLE of Standard Deviation	46.32		
nu star	177.2		
Approximate Chi Square Value (.05)	153.5	Nonparametric Statistics	
Adjusted Level of Significance	0.0752	90% CLT UCL	142.4
Adjusted Chi Square Value	150.9	90% Jackknife UCL	143.5
		90% Standard Bootstrap UCL	141.9
Anderson-Darling Test Statistic	0.318	90% Bootstrap-t UCL	148.1
Anderson-Darling 5% Critical Value	0.73	90% Hall's Bootstrap UCL	164.6
Kolmogorov-Smirnov Test Statistic	0.178	90% Percentile Bootstrap UCL	142.5
Kolmogorov-Smirnov 5% Critical Value	0.245	90% BCA Bootstrap UCL	145.9
Data appear Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	164.7
		95% Chebyshev(Mean, Sd) UCL	182.3
		97.5% Chebyshev(Mean, Sd) UCL	206.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	254.7
90% Approximate Gamma UCL	145.2		
90% Adjusted Gamma UCL	147.8		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	

Result (lead) **90UCL Output**

General Statistics			
Number of Valid Observations	12	Number of Distinct Observations	12
Raw Statistics		Log-transformed Statistics	
Minimum	19.4	Minimum of Log Data	2.965
Maximum	38.6	Maximum of Log Data	3.653
Mean	29.7	Mean of log Data	3.378
Median	29.85	SD of log Data	0.176
SD	4.934		
Coefficient of Variation	0.166		
Skewness	-0.264		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.978	Shapiro Wilk Test Statistic	0.945
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	31.64	90% H-UCL	31.99
		90% Chebyshev (MVUE) UCL	34.25
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	36.3
90% Adjusted-CLT UCL	31.45	97.5% Chebyshev (MVUE) UCL	39.15
90% Modified-t UCL	31.62	99% Chebyshev (MVUE) UCL	44.75
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	27.86	Data appear Normal at 5% Significance Level	
Theta Star	1.066		
MLE of Mean	29.7		
MLE of Standard Deviation	5.627		
nu star	668.7		
Approximate Chi Square Value (.05)	622.3	Nonparametric Statistics	
Adjusted Level of Significance	0.0752	90% CLT UCL	31.53
Adjusted Chi Square Value	616.8	90% Jackknife UCL	31.64
		90% Standard Bootstrap UCL	31.41
Anderson-Darling Test Statistic	0.241	90% Bootstrap-t UCL	31.63
Anderson-Darling 5% Critical Value	0.731	90% Hall's Bootstrap UCL	31.7
Kolmogorov-Smirnov Test Statistic	0.14	90% Percentile Bootstrap UCL	31.46
Kolmogorov-Smirnov 5% Critical Value	0.245	90% BCA Bootstrap UCL	31.31
Data appear Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	33.97
		95% Chebyshev(Mean, Sd) UCL	35.91
		97.5% Chebyshev(Mean, Sd) UCL	38.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	43.87
90% Approximate Gamma UCL	31.92		
90% Adjusted Gamma UCL	32.2		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	

Result (zinc) **90UCL Output**

General Statistics			
Number of Valid Observations	12	Number of Distinct Observations	11
Raw Statistics		Log-transformed Statistics	
Minimum	96.6	Minimum of Log Data	4.571
Maximum	194	Maximum of Log Data	5.268
Mean	138.1	Mean of log Data	4.902
Median	123.5	SD of log Data	0.233
SD	33.67		
Coefficient of Variation	0.244		
Skewness	0.805		
Relevant UCL Statistics			

APPENDIX D-6 Riverbank Area Surface Soil Data – ProUCL Output

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.867	Shapiro Wilk Test Statistic	0.906
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	151.3	90% H-UCL	152.5
		90% Chebyshev (MVUE) UCL	165.9
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	178.6
90% Adjusted-CLT UCL	152.1	97.5% Chebyshev (MVUE) UCL	196.1
90% Modified-t UCL	151.7	99% Chebyshev (MVUE) UCL	230.7
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	14.83	Data appear Normal at 5% Significance Level	
Theta Star	9.306		
MLE of Mean	138.1		
MLE of Standard Deviation	35.84		
nu star	356		
Approximate Chi Square Value (.05)	322.3	Nonparametric Statistics	
Adjusted Level of Significance	0.0752	90% CLT UCL	150.5
Adjusted Chi Square Value	318.4	90% Jackknife UCL	151.3
		90% Standard Bootstrap UCL	149.9
Anderson-Darling Test Statistic	0.611	90% Bootstrap-t UCL	153.1
Anderson-Darling 5% Critical Value	0.732	90% Hall's Bootstrap UCL	150.4
Kolmogorov-Smirnov Test Statistic	0.236	90% Percentile Bootstrap UCL	149.4
Kolmogorov-Smirnov 5% Critical Value	0.245	90% BCA Bootstrap UCL	150.9
Data appear Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	167.2
		95% Chebyshev(Mean, Sd) UCL	180.4
		97.5% Chebyshev(Mean, Sd) UCL	198.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	234.8
90% Approximate Gamma UCL	152.5		
90% Adjusted Gamma UCL	154.4		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	

95UCL Output - used for guidance only

General UCL Statistics for Data Sets with Non-Detects

User Selected Options	
From File	S:\Jobs\0219-018-900-SIUF-OU1-Upland\Data\ProUCL\SIUF_OU1_ProUCL_INPUT_revND.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Result (antimony) **95UCL Output - for guidance only**

General Statistics			
Number of Valid Data	12	Number of Detected Data	9
Number of Distinct Detected Data	9	Number of Non-Detect Data	3
		Percent Non-Detects	25.00%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.556	Minimum Detected	-0.587
Maximum Detected	2.21	Maximum Detected	0.793
Mean of Detected	0.945	Mean of Detected	-0.167
SD of Detected	0.546	SD of Detected	0.464
Minimum Non-Detect	0.515	Minimum Non-Detect	-0.664
Maximum Non-Detect	0.537	Maximum Non-Detect	-0.622
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	3
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	9
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	25.00%

Warning: There are only 9 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.734	Shapiro Wilk Test Statistic	0.844
5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.774	Mean	-0.459
SD	0.558	SD	0.659
95% DL/2 (t) UCL	1.064	95% H-Stat (DL/2) UCL	1.118
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.742	Mean in Log Scale	-0.44
SD	0.59	SD in Log Scale	0.632

APPENDIX D-6 Riverbank Area Surface Soil Data – ProUCL Output

95% MLE (t) UCL	1.048	Mean in Original Scale	0.78
95% MLE (Tiku) UCL	1.052	SD in Original Scale	0.553
		95% Percentile Bootstrap UCL	1.047
		95% BCA Bootstrap UCL	1.146
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	3.196	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	0.296		
nu star	57.53		
A-D Test Statistic	0.784	Nonparametric Statistics	
5% A-D Critical Value	0.723	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.723	Mean	0.848
5% K-S Critical Value	0.28	SD	0.477
Data follow Appr. Gamma Distribution at 5% Significance Level		SE of Mean	0.146
		95% KM (t) UCL	1.11
Assuming Gamma Distribution		95% KM (z) UCL	1.088
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.104
Minimum	0.44	95% KM (bootstrap t) UCL	1.729
Maximum	2.21	95% KM (BCA) UCL	1.109
Mean	0.819	95% KM (Percentile Bootstrap) UCL	1.101
Median	0.637	95% KM (Chebyshev) UCL	1.484
SD	0.519	97.5% KM (Chebyshev) UCL	1.759
k star	3.05	99% KM (Chebyshev) UCL	2.299
Theta star	0.268		
Nu star	73.19	Potential UCLs to Use	
AppChi2	54.49	95% KM (Percentile Bootstrap) UCL	1.101
95% Gamma Approximate UCL	1.1		
95% Adjusted Gamma UCL	1.151		

Note: DL/2 is not a recommended method.

Result (arsenic) **95UCL Output - for guidance only**

General Statistics			
Number of Valid Observations	12	Number of Distinct Observations	12
Raw Statistics		Log-transformed Statistics	
Minimum	3.65	Minimum of Log Data	1.295
Maximum	9.5	Maximum of Log Data	2.251
Mean	4.978	Mean of log Data	1.565
Median	4.335	SD of log Data	0.275
SD	1.689		
Coefficient of Variation	0.339		
Skewness	2.22		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.68	Shapiro Wilk Test Statistic	0.764
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	5.853	95% H-UCL	5.818
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	6.679
95% Adjusted-CLT UCL	6.113	97.5% Chebyshev (MVUE) UCL	7.427
95% Modified-t UCL	5.905	99% Chebyshev (MVUE) UCL	8.895
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	9.586	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.519		
MLE of Mean	4.978		
MLE of Standard Deviation	1.608		
nu star	230.1		
Approximate Chi Square Value (.05)	196	Nonparametric Statistics	
Adjusted Level of Significance	0.029	95% CLT UCL	5.78
Adjusted Chi Square Value	191.2	95% Jackknife UCL	5.853
		95% Standard Bootstrap UCL	5.743
Anderson-Darling Test Statistic	1.422	95% Bootstrap-t UCL	8.162
Anderson-Darling 5% Critical Value	0.731	95% Hall's Bootstrap UCL	10.4
Kolmogorov-Smirnov Test Statistic	0.301	95% Percentile Bootstrap UCL	5.838
Kolmogorov-Smirnov 5% Critical Value	0.245	95% BCA Bootstrap UCL	6.129
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	7.103
		97.5% Chebyshev(Mean, Sd) UCL	8.023
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	9.829
95% Approximate Gamma UCL	5.844		
95% Adjusted Gamma UCL	5.991		
Potential UCL to Use		Use 95% Student's-t UCL	5.853
		or 95% Modified-t UCL	5.905

Result (copper) **95UCL Output - for guidance only**

General Statistics			
Number of Valid Observations	12	Number of Distinct Observations	12

APPENDIX D-6 Riverbank Area Surface Soil Data – ProUCL Output

Raw Statistics		Log-transformed Statistics	
Minimum	75.3	Minimum of Log Data	4.321
Maximum	229	Maximum of Log Data	5.434
Mean	125.9	Mean of log Data	4.783
Median	120	SD of log Data	0.33
SD	44.87		
Coefficient of Variation	0.357		
Skewness	1.26		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.887	Shapiro Wilk Test Statistic	0.957
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	149.1	95% H-UCL	153.2
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	178.2
95% Adjusted-CLT UCL	152.2	97.5% Chebyshev (MVUE) UCL	201
95% Modified-t UCL	149.9	99% Chebyshev (MVUE) UCL	245.8
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	7.382	Data appear Normal at 5% Significance Level	
Theta Star	17.05		
MLE of Mean	125.9		
MLE of Standard Deviation	46.32		
nu star	177.2		
Approximate Chi Square Value (.05)	147.4	Nonparametric Statistics	
Adjusted Level of Significance	0.029	95% CLT UCL	147.2
Adjusted Chi Square Value	143.2	95% Jackknife UCL	149.1
		95% Standard Bootstrap UCL	146.9
Anderson-Darling Test Statistic	0.318	95% Bootstrap-t UCL	161.1
Anderson-Darling 5% Critical Value	0.73	95% Hall's Bootstrap UCL	257.1
Kolmogorov-Smirnov Test Statistic	0.178	95% Percentile Bootstrap UCL	147.3
Kolmogorov-Smirnov 5% Critical Value	0.245	95% BCA Bootstrap UCL	152.9
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	182.3
		97.5% Chebyshev(Mean, Sd) UCL	206.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	254.7
95% Approximate Gamma UCL	151.3		
95% Adjusted Gamma UCL	155.7		
Potential UCL to Use		Use 95% Student's-t UCL	149.1

Result (lead) **95UCL Output - for guidance only**

General Statistics			
Number of Valid Observations	12	Number of Distinct Observations	12
Raw Statistics		Log-transformed Statistics	
Minimum	19.4	Minimum of Log Data	2.965
Maximum	38.6	Maximum of Log Data	3.653
Mean	29.7	Mean of log Data	3.378
Median	29.85	SD of log Data	0.176
SD	4.934		
Coefficient of Variation	0.166		
Skewness	-0.264		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.978	Shapiro Wilk Test Statistic	0.945
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	32.26	95% H-UCL	32.77
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	36.3
95% Adjusted-CLT UCL	31.93	97.5% Chebyshev (MVUE) UCL	39.15
95% Modified-t UCL	32.24	99% Chebyshev (MVUE) UCL	44.75
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	27.86	Data appear Normal at 5% Significance Level	
Theta Star	1.066		
MLE of Mean	29.7		
MLE of Standard Deviation	5.627		
nu star	668.7		
Approximate Chi Square Value (.05)	609.7	Nonparametric Statistics	
Adjusted Level of Significance	0.029	95% CLT UCL	32.04
Adjusted Chi Square Value	601.1	95% Jackknife UCL	32.26
		95% Standard Bootstrap UCL	31.92
Anderson-Darling Test Statistic	0.241	95% Bootstrap-t UCL	32.28
Anderson-Darling 5% Critical Value	0.731	95% Hall's Bootstrap UCL	32.21
Kolmogorov-Smirnov Test Statistic	0.14	95% Percentile Bootstrap UCL	31.93
Kolmogorov-Smirnov 5% Critical Value	0.245	95% BCA Bootstrap UCL	31.77

APPENDIX D-6 Riverbank Area Surface Soil Data – ProUCL Output

Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	35.91
		97.5% Chebyshev(Mean, Sd) UCL	38.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	43.87
95% Approximate Gamma UCL	32.57		
95% Adjusted Gamma UCL	33.04		
Potential UCL to Use		Use 95% Student's-t UCL	32.26

Result (zinc) **95UCL Output - for guidance only**

General Statistics			
Number of Valid Observations	12	Number of Distinct Observations	11
Raw Statistics		Log-transformed Statistics	
Minimum	96.6	Minimum of Log Data	4.571
Maximum	194	Maximum of Log Data	5.268
Mean	138.1	Mean of log Data	4.902
Median	123.5	SD of log Data	0.233
SD	33.67		
Coefficient of Variation	0.244		
Skewness	0.805		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.867	Shapiro Wilk Test Statistic	0.906
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	155.5	95% H-UCL	157.6
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	178.6
95% Adjusted-CLT UCL	156.5	97.5% Chebyshev (MVUE) UCL	196.1
95% Modified-t UCL	155.9	99% Chebyshev (MVUE) UCL	230.7
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	14.83	Data appear Normal at 5% Significance Level	
Theta Star	9.306		
MLE of Mean	138.1		
MLE of Standard Deviation	35.84		
nu star	356		
Approximate Chi Square Value (.05)	313.3	Nonparametric Statistics	
Adjusted Level of Significance	0.029	95% CLT UCL	154
Adjusted Chi Square Value	307.2	95% Jackknife UCL	155.5
		95% Standard Bootstrap UCL	153.3
Anderson-Darling Test Statistic	0.611	95% Bootstrap-t UCL	157.6
Anderson-Darling 5% Critical Value	0.732	95% Hall's Bootstrap UCL	153
Kolmogorov-Smirnov Test Statistic	0.236	95% Percentile Bootstrap UCL	154
Kolmogorov-Smirnov 5% Critical Value	0.245	95% BCA Bootstrap UCL	154.9
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	180.4
		97.5% Chebyshev(Mean, Sd) UCL	198.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	234.8
95% Approximate Gamma UCL	156.9		
95% Adjusted Gamma UCL	160		
Potential UCL to Use		Use 95% Student's-t UCL	155.5

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